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Bell Telephone MAGAZINE

Telephone Communication in a New Era • BARTLETT T. MILLER

The Telephone's Inventor Elected to Hall of Fame

Spanning the Continent by Radio Relay • RICHARD D. CAMPBELL and EARL SCHOOLEY

Showing Our Customers the Elements of Good Service WALTER V. BROWN

Bell Companies in the East Withstand Heaviest Blow JUDSON S. BRADLEY

Where the World's Telephones Are • ELIZABETH WRENSHALL

American Telephone & Telegraph Company • New York

XUM

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A Medium of Suggestion & a Record of Progress

Published for the supervisory forces of the Bell System by the Information Department of AMERICAN TELEPHONE AND TELEGRAPH CO., *195 Broadway, New York 7, N. Y.*
LEROY A. WILSON, *President;* CARROLL O. BICKELHAUPT, *Sec.;* DONALD R. BELCHER, *Treas.*

Who's Who & What's What

in This Issue

WHEN BARTLETT T. MILLER gave the address which is printed on page 197 & ff., on October 11, 1950, he was a vice president of the American Telephone and Telegraph Company, with staff responsibilities. Since November 3, he has been vice president in charge of Public Relations—retaining at the same time some of his previous duties. His telephone career began in 1910, when he joined the Colorado Telephone Company. Traffic and Commercial work in the west and with the New England Telephone and Telegraph Company preceded his successive appointments with the latter Company as vice president, Public Relations; vice president, Public Relations and Personnel; and vice president and general manager. The last-named position he relinquished in 1946 to become an assistant vice president in the Department of Operation and Engineering at A. T. & T. A year later he became vice president in charge of the Long Lines Department, and he returned to A. T. & T. Headquarters early in 1949. To this MAGAZINE for Winter 1948–49 he contributed "The International Telecommunication Conference of 1947."

A CAREER in the Bell System began for RICHARD D. CAMPBELL when he went to work for the Chesapeake and Potomac Telephone Company in 1922 as a student engineer. Eight years of foreign wire relations work followed, until his transfer to the A. T. & T. Company in 1930. There he has worked on radio engineering problems in the Department of Development and Research, Operation C Department, and the O. & E. Department. Responsibility for frequency assignments for telephone company radio systems was a major part of this activity, and in this capacity he has served as a Bell System representative on United States delegations to four international radio conferences. Recently he has been in charge of a group working on engineering problems in connection with the Bell System's use of radio for point-to-point service.

Bartlett T. Miller

Richard D. Campbell

Earl Schooley

Walter V. Brown

Judson S. Bradley

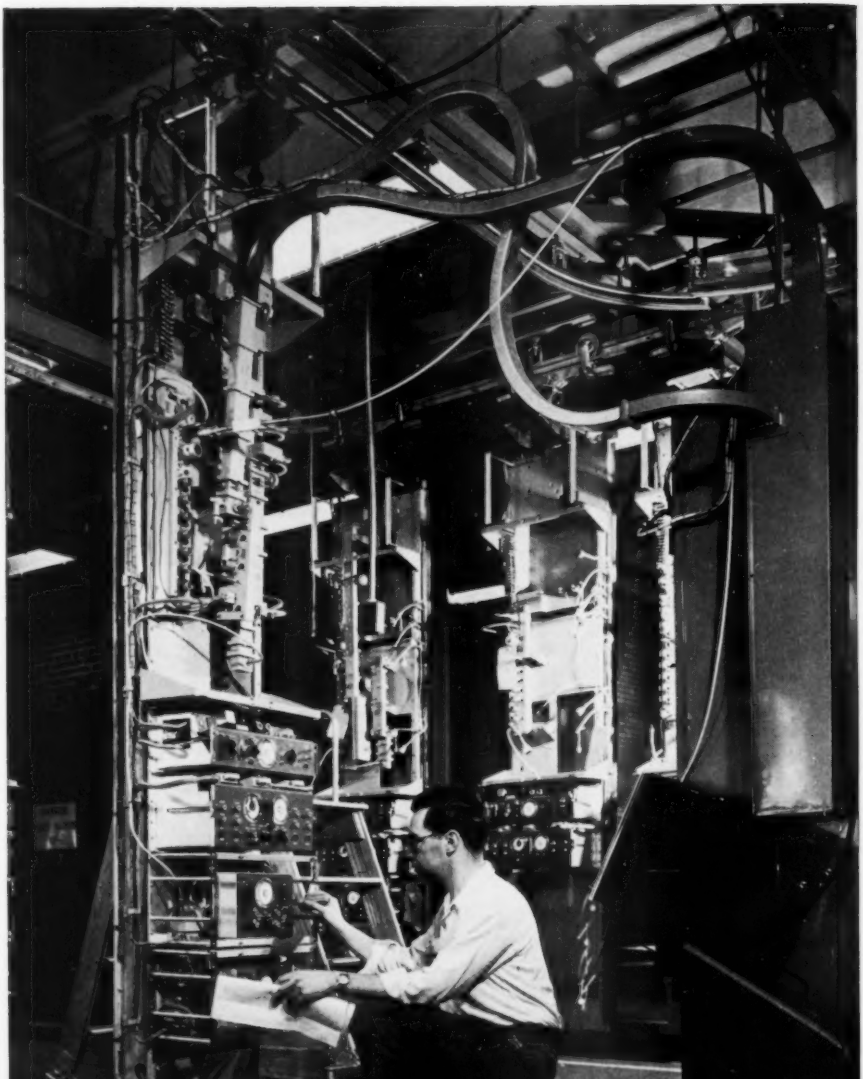
Elizabeth Wrenshall

EARL SCHOOLEY's first telephone job was with the Bolivar (Mo.) Telephone Company. There he was a combination of night operator, lineman, installer, troubleshooter —and motion picture operator in the local movie house, which was owned by the telephone manager. In 1927 he joined the Long Lines Department in St. Louis as a student, and two years later became a technical employee in the division office there. A transfer to Kansas City and a return to St. Louis preceded his assignment to the Engineering Department in New York. Here he worked on carrier systems and in 1944 was appointed coaxial cable carrier engineer and in 1946 was appointed carrier and electrical coördination engineer. He went to Washington, D. C., in 1948, as division plant engineer, and returned to New York after a year and a half as facilities engineer. He became engineer of transmission in February 1950, and last December was transferred to the Commercial Department of Long Lines to assume the new post of commercial development engineer.

IF A SLIGHT SPICING of showmanship is detected in the activities which WALTER V. BROWN describes in this issue, it is because that contributes to the element of entertainment which is essential in conveying useful telephone information to customers during eleven million face-to-face contacts in the course of a year. Mr. Brown's telephone career began with the Southern New England Telephone Company in New Haven in 1927. After a few years in the Engineering and Commercial Departments he changed over to the General Information Department, where he was information supervisor until 1943. In that year he transferred to the Information Department of the A. T. & T. Company as public relations supervisor. Three years later he was made public relations manager, and since April of 1950 he has been public film and display manager.

THE PRESENT ARTICLE is JUDSON S. BRADLEY's fifth description in these pages since 1936 of storm damage and telephone reconstruction, its most recent predecessor being "The Winter's Toll Was Heavy from Texas to the Dakotas," which appeared in the issue for Spring 1949. Joining the Information Department of the Southern New England Telephone Company in

(*Continued on page 270*)



Testing microwave radio transmitter-receiver equipment in a plant of the Western Electric Company. Wave-guide "plumbing" is used to make the connection with the test equipment at the right. ***See "Spanning the Continent by Radio Relay," beginning on page 215***

A Talk before the U. S. Independent Telephone Association On Mutual Problems, Responsibilities, and Opportunities Of the American Telephone Industry

Telephone Communication In a New Era

Bartlett T. Miller

ONE THING that distinguishes telephone people is that all of us have the same objective of giving the best possible service to everyone who wants it. We have known for a long time that the way to do that—and the only way—is by working together. Your invitation to me to take part in this Convention is further evidence of how you feel about it, and I assure you I am here in the same spirit.

Of course, the test of our work is in the progress we make and the results we obtain. And it seems to me that never in the long and resultful history of this industry has there been a finer accomplishment than during these last few years. I am not saying this as a representative of the Bell System, or as a member of any particular organization within the industry, but rather as a telephone man who feels a tremendous pride in what the entire group of telephone men and women have jointly brought about. Certainly it is one of the great industrial achievements of our time.

Five years ago we found ourselves with a mountain of held orders that had piled up because telephone production facilities had gone to war. We were also to find very quickly that a new peace-time army of people wanted telephones who had not wanted or been able to afford them before. More families wanted and were getting new housing through the biggest housing program ever undertaken. And for almost every new home, as well as for millions of older ones, the comfort and convenience and security afforded by the telephone were also desired. Then too, the people of this country have been moving on a vast scale; we have been seeing the shifting of great groups of our population from one location or area to another. As

people have moved, we have moved with them—connecting and disconnecting and then connecting again—so that the volume of work in this respect alone has far exceeded all previous experience.

Today, our industry is serving some 42 million telephones, or 15 million more than at the end of the war. That is an astounding increase. And equally impressive, I think, although less well known, is the fact that to obtain this net gain, we have had to connect about 40 million telephone instruments in the last five years—almost as many as the total number now in service.

What the Figures Show

THOSE ARE big figures. But their greatest significance, it seems to me, is not in what they tell of the past, but in what they suggest for the future. The fact of prime importance is that we are now providing, and the country is using, telephone service on a tremendously expanded scale. The average man is looking at the service we have to offer and judging it under new standards of value, and he likes what he sees. It is good service, and fast, and convenient to use. It is courteous and friendly service. It is dependable service that can be relied on night and day. Those are not new characteristics, to be sure—but the sheer abundance of excellent telephone service today has made all these fine qualities more evident to more people.

Furthermore, the telephone has become more and more necessary as people live at greater distances from other people they want to talk to. And, in our present-day economy, it is cheaper than at any time in the past. Telephone service has always been an outstanding value—the one service in the home, for example, that people can have for a modest monthly charge without having to incur any investment of their own as they do when they buy ranges and refrigerators and washing machines, and all the other things they must have in order to use gas or electrical service. Today this telephone value is bigger than ever before. The average customer pays less for it, in relation to his income, than he used to, and he gets more for what he pays. Our service is a bargain. It's a best-seller. It's a buy.

This is as it should be. This is what we have dreamed about and worked for. This is what we have always wanted. I don't mean it is the telephone millennium—of course it isn't—but this service we are providing today is a long, long way ahead of what it was in years gone by. And I'm proud, as you are, that we and our associates in the industry, past and present, are the ones responsible. We're all of us to blame. We brought it on ourselves.

How? Well, each of us could name a lot of reasons, but there are three among others that seem to me particularly important:

First, we have never stopped trying to invent things and think up ways of making the service better. And, fortunately for all concerned, the ways of improvement have been at the same time the ways of economy.

Second, we have kept firmly in mind that the person who wants to telephone may want to call anybody, anytime, anywhere—and we have

never forgotten that the only way to make that possible is for every part of our industry to work together in carrying out our joint responsibility.

Third, over the years we have built character, including financial character and high credit standing.

Where the Tides of Progress Trend

Now, with those ideas in mind, let's look at a few present-day events and problems that affect us very closely. We've all heard of moving with the stream, running with the tide, and so on. Nowadays there are some strong tides running that we started ourselves, and it's up to us to navigate them. Take rural service, for example. If telephone service generally were scarce or slow or limited or unreliable, or all of those things, I doubt that many farmers would want it. But the fact is that we have made it generally fast and plentiful and good, and it will take your voice almost anywhere you want to send it, and so of course farm people want it. Why shouldn't they? And we must give it to them.

I know that that is our desire as well as our obligation. I realize, as you do, that the industry has done a magnificent job in extending and improving service in rural areas. I appreciate that the farmers of America have always had a far better and more abundant telephone service than the farmers of any country in the world, and more so today than ever before. As evidence of that, just since the war we have brought about a 50 percent increase in farm telephones, and half the country's farmers now have service, including an increasing number in the more remote areas of the nation.

So we have made great progress in the rural field. But we also know that whatever tastes good whets the appetite for more. Progress sets up a demand for more progress. And just as sure as today is today and tomorrow is tomorrow, if we don't meet that keen continuing demand, somebody else will.

Another development that is running a strong tide today (and here again, we started it ourselves) is the use of radio in telephone communication. Already we have a wide variety of techniques and services in operation, and I am sure there will be more. Years ago we bridged the oceans and now, with radio relay, we are again spanning the continent. The telephone is talking from cars on the roads and from highballing trains, from planes in the clouds and from boats in the rivers and lakes and along the coastal seaways. It is bringing a new security to remote and hitherto isolated corners of the land.

How far will the radio art eventually extend the telephone's frontiers? That is anybody's guess—but if there is one thing we telephone people have learned from experience, it is not to underestimate future potentials. We know we can't foresee the end result of the new ideas and new techniques and new services we set in motion. We can't put limits on tomorrow.

Service of Limitless Scope

AFTER ALL, we have now shown the world that telephone service is not limited to talking over a wire from

an office or armchair. We have pulled aside a curtain and given the public a whole new outlook to explore. Having done this, we must accept the consequences. We must be prepared to serve—not here and there or in bits and pieces—but wherever the need exists. And we must face the fact that if we do not serve in that way, others may jump in to fill the gaps.

One way or another, the public are going to get what they want. They have a right to expect that we will give them what they want. And I am sure that in all these new fields of service, no less than in others, we shall be wise in continuing to make the public's wants our opportunity. As I said earlier, one of the big reasons for the progress of our industry over the years is that we have worked faithfully to the end that anyone might talk with anyone else, anytime and anywhere. In this new era of communications—this new day that stretches out ahead of us—the same principle will be every bit as important in bringing new benefits to the public and success to our over-all efforts.

Why a New Era?

I HAVE CALLED THIS a new era—a new day. It seems to me there are many reasons for calling it that. In addition to the enormous increase in the sheer volume of telephone service, and the use of radio which I have already mentioned, other new developments are coming along apace. Already, operators are dialing about 30 percent of all toll board and long distance calls. Local service areas are being extended geographically, as well as in the number of users who can call each other without toll charges. Metropolitan service areas are being enlarged. The range of direct customer dialing is increasing and we are not far from the time when telephone users in certain places can begin to dial at least some of their own long-haul calls. Community dial offices are multiplying. Television is on the march.

For our customers, much of this progress has the excellent result of making the service a great deal more convenient and simple to use. But for us who give the service, one result is greater complexity in operations. There is a paradox of a sort—we are making things more complicated in order to make them more simple. A parallel result is that the operations of all companies in the industry touch each other at more points. In the working out of each new step forward, the problems and situations of all companies must be considered in order that the whole public may best be served.

Fortunately, we in this industry have the background, the experience, and above all the will to sit down together and jointly work out satisfactory answers to all these problems. That is what we have been doing, are doing, and will continue to do. This applies to radio services. It applies to all the problems associated with toll dialing. It applies to community dial projects and the frequent arrangement of having one company do the assistance-operating for another company's CDO.* In short, on all matters of common concern we shall, I confidently expect, keep right on contributing mutually

* Community dial office.

toward solutions that are in the best interest of all our customers.

Problems of Finance

NOW I SHOULD LIKE to say a few words about the third fundamental that I mentioned earlier as having contributed so much to the progress of this business. I mean the building of character and especially, in this discussion, financial character.

There is no organization in the telephone industry that has not faced tremendous financial problems in the past few years. We have all had them—big companies, medium-sized companies, and little companies. The cost of providing telephone service has gone up, up, and up. Demand for service has required continuous heavy expenditures for new construction and the obtaining of huge amounts of new capital. And the years we have been through have shown us these things:

They have shown that the building of high credit standing over the years is indispensable in order to meet public demand for more service and improving service.

They have shown that in the long run no telephone company can really do a job that is "tops" unless it has adequate earnings.

They have shown the necessity for making every possible effort to bring about the fair pricing of telephone service.

And they have shown that good service, fairly priced in the light of current conditions, is still a bargain that people want more than they ever wanted it before.

So I want to give special emphasis here to the work that is being done to meet problems of earnings and pricing, particularly in the case of small companies for which these problems present the greatest difficulties. Your Association, through its Committee on Problems of Small Companies, is doing a fine job in analyzing situations and mapping practical programs of action. Likewise the work of the state associations is of utmost importance and deserves the active coöperation and support of all of us.

This kind of work seems to me particularly important right now. Bear in mind that demand is once again quickening and is on a rising curve. The defense situation is bringing new problems and we must be prepared to meet them. We need plant margins that we do not now have—and we need them all the more because we do not yet know what sort of restrictions may soon be placed on materials and on plant construction. The situation is urgent, and the first essential is to meet these underlying problems of rates, earnings, and financing as well as we possibly can.

Good Public Relations

THERE IS another thing that seems to me of first importance today. That is that we do everything we can to keep close to the public's thinking and to make our own ideas and policies and problems—and our accomplishments—crystal-clear to the people we serve. I have three reasons for emphasizing this point.

One is that all our experience has shown the necessity of building good relations with the public in order to give the best possible service.

The second is that we now have a new public. We have millions of new customers who don't yet know us nearly as well as the old ones do. They are just beginning to make our acquaintance. Of course, all through the years we have had a steady parade of new customers—but we have never had so many come along so fast as in the last five years. Therefore, while the process of gaining mutual understanding may not be essentially different from what it has always been, we simply have a lot more of it to do.

The third reason I have in mind is that all of us together—the telephone industry and the public—are living in a period of tension and change. None of us can be quite sure of what is going to happen next. But we all feel in our bones that events of the utmost consequence lie ahead. And the challenge to us who render telephone service is that we shall not only so conduct ourselves, but also so present ourselves to the public we serve, that they will have whole-hearted confidence in our ability, sympathetic understanding of our problems and difficulties, and a friendly respect and liking for us as people.

I have been speaking of a new era in communications: of the fulfillment of so much for which we have labored in the past, of the progress of today and the promise of tomorrow. But it must already be clear to you that I am not suggesting we have any reason to be complacent. We have none. Our country today faces great problems and grave dangers—perhaps the most serious we have ever been called upon to face. There are hard tasks ahead, and we shall have to summon all our capacity to meet them.

Building for Progress

BUT WE HAVE the capacity, and the courage to use it. We have built a communication system in this country that is a mighty bulwark of defense—a system far better and more extensive and more efficient than in the years before World War II. We have the knowledge and skill and resources to make this system even stouter and stronger and better day by day. We are an army of men and women 600,000 strong who know our job and know how to do it together. And we have never failed. I am confident, and I know you are confident, that with unity of purpose and consistent devotion to the common good, we shall do our full part in helping to maintain the freedom of the United States of America. And in so doing we shall also, I am sure, write a new and important chapter in the bright record of telephone progress.

XUM

The Bell System's Number One Job

A statement by

Leroy A. Wilson

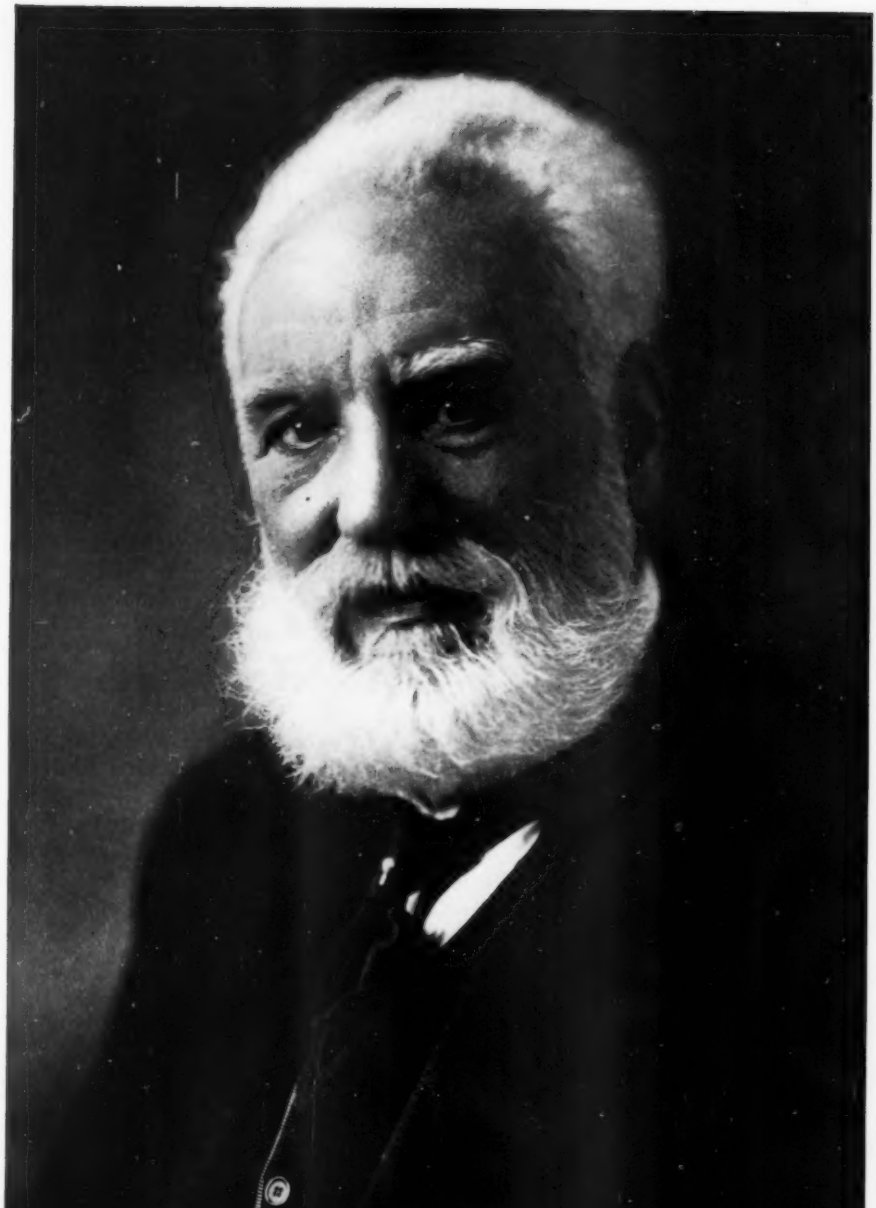
President, American Telephone
and Telegraph Company

THE BELL SYSTEM is well prepared to do its full part in meeting the national emergency. That is the Number One telephone job in 1951. The System has spent five billion dollars since the war to expand and improve the country's telephone network. More than 35,000,000 Bell telephones are in service—twice as many as in 1940. New and improved methods of communication are being more and more used.

The telephone is essential for military and defense production purposes and these will continue to get first attention. Construction work is moving right ahead on many special defense projects. Fast and plentiful telephone communications are equally vital to the expansion of production, and the Bell Companies are determined to meet every such need. Additional facilities will also be required to provide service to people who are waiting. Shortages of materials add severely to this problem, but every effort will be continued to meet civilian needs to the full extent that national policy allows.

With a large continuing construction program and no let-up in demand for service, additional financing has been authorized by the stockholders so that the Bell System may be in a position to obtain new capital when it is needed. To attract and protect the savings of investors, earnings must be maintained at adequate levels. Accordingly, various Bell Companies have applied for further increases in telephone rates and other applications will be made. This must be done in order that the Companies may continue to succeed in providing the service the nation depends on during these critical times.

Reprinted from *Advance Management Magazine* for January 1951



ALEXANDER GRAHAM BELL
1847–1922

Alexander Graham Bell's Varied Interests and Numerous Contributions to the Welfare of Mankind Were Important Factors in the Award of This Signal Honor

The Telephone's Inventor Elected to Hall of Fame

THE YEAR 1951 will include not only the seventy-fifth anniversary of the telephone but the enshrinement of its inventor, Alexander Graham Bell, in the Hall of Fame.

Dr. Bell was one of six famous Americans to be elected to the Hall of Fame on November 1, 1950. Others chosen for this signal honor were Susan B. Anthony, suffrage leader and eighth woman to be elected; Josiah Willard Gibbs, founder of the science of physical chemistry; Dr. William Gorgas, medical scientist, who rid the Canal Zone of yellow fever; Theodore Roosevelt, 26th President; and Woodrow Wilson, 28th President and inspiration for the League of Nations.

The telephone, during the three-quarters of a century since it carried its first complete message, has had incalculable influence upon the world, and has to no small degree shaped the pattern of modern life. It has given employment to hundreds of thousands of men and women, while to countless millions it has come to be an indispensable tool of living. Its importance in business and social affairs, in the maintenance of family ties, and in the administration of government, need no recounting here.

But it was not for the telephone alone that Dr. Bell eminently deserved the honor of a place in the Hall of Fame. Indeed, the telephone is so ubiquitous in our lives that we in the telephone business are in some danger of overlooking his claims to greatness in other fields. He was a versatile genius who contributed to the welfare of mankind in many ways.

A biographical memoir of Dr. Bell, prepared for the National Academy of Sciences in 1943 by Harold S. Osborne, Chief Engineer of the American Telephone and Telegraph Company, gives a comprehensive account of Bell's life. From it is reprinted here that considerable portion which deals with his non-telephonic interests and which gives, we believe, a critical evaluation of this great American's many achievements.

EDITOR.

DR. BELL'S INTERESTS were much broader than telephony, and the breadth of these interests led him to turn his attention into other fields as rapidly as his obligations to the developers of the telephone made this

The Hall of Fame

THE HALL OF FAME FOR GREAT AMERICANS was originated by Dr. Henry J. MacCracken, former Chancellor of New York University, and was made possible by the generosity of Mrs. Finley J. Shepard.

Physically, it consists of an open air colonnade and a massive substructure on the campus of New York University, University Heights, New York City. A bronze plaque is installed for each individual elected, and this is usually followed or accompanied by the unveiling of a bust presented by his or her admirers.

Hall of Fame electors are chosen by the senate of New York University from people of prominence in educational and public life. At least a majority of the electors must concur before a candidate can be elected, and no more than seven may be elected at any one time. Anyone may nominate a candidate for the Hall of Fame, but no nomination will be considered until at least twenty-five years after the death of the person proposed.

Elections take place every five years, and the first was held in 1900. The elections of 1950 increased to 83 the total of great Americans enshrined in the Hall of Fame.

possible. As leisure and wealth came to him from his telephone invention, it became possible for him to devote his time to researches in numerous subjects which interested him and which gave opportunity for further service to mankind.

His Work with the Deaf

RUNNING through all of Bell's adult life is his interest in improving the teaching of the deaf. This began even before he left London, and in this country as early as 1871 he accepted engagements in Boston to explain the application of his father's system of visible speech to teaching the deaf and dumb to talk. At that time, deaf children were generally taught to speak among themselves by sign language. Many leading authorities considered that it was impracticable and a waste of time to try to teach speech to the deaf and dumb—it was even commonly supposed that their organs of speech had been impaired. At one time Bell, as well as his father, had held, as he expressed it, "an obstinate disbelief in the powers of lip reading." Later he became convinced of these powers, partly perhaps through the ease with which he could converse with Mabel Hubbard, who had become adept at lip-reading.

Characteristically, when Bell recognized his misconception he was quick to correct it in an active way. As early as 1872 he began a crusade for recognizing the intellectual possibilities of deaf children and for teaching them to speak and read lips rather than being content to teach them sign language. His influence spread rapidly, helped by the success of his application of visible speech to teaching the deaf to talk. On Janu-

Bell's interest in the deaf was life-long. In this picture of a group of pupils and teachers at the Boston School for the Deaf—"Sarah Fuller's School"—taken in 1871, Bell is at the right at the top of the steps

ary 24, 1874, he addressed the first convention of Articulation Teachers of the Deaf and Dumb and he continued to take an active part in this and other organizations of a similar nature. While this work was interrupted in the years 1875 to 1878 by his activities on the telephone and associated inventions he threw himself into the work again on his return to America in 1878.

In 1880, he received the Volta Award of 50,000 francs for his invention of the telephone. With this he founded the Volta Laboratory Association (later the Volta Bureau), which was largely devoted to work for the deaf. In 1883, after an exhaustive study, he presented before the National Academy of Sciences a memoir: "Upon the formation of a deaf variety of the human race." In this he traced the eugenic dangers of the enforced segragation of deaf people which resulted from teaching them sign language rather than teaching them to speak and read lips. In 1884, he made a plea before the National Eucation Association for the opening of day schools for the deaf as one means of reducing this danger.

There were tendencies for the proponents of sign language and of articulation to break into two hostile camps. However, Bell's conciliatory policy held the group together and led in 1890 to the organization of the American Association to Promote the Teaching of Speech to the Deaf. Bell was President of this organiza-

Experimenting in eugenics for 30 years, Bell developed a flock of sheep whose ewes bore twins or triplets half the time, instead of single lambs

tion and heavily supported its work, giving a total of more than $300,000.

In 1888, at the invitation of the Royal Commission appointed by the British government to study the condition of the deaf, Bell gave exhaustive testimony before them based upon his experience and upon an extensive study of conditions in America. He was appointed an expert special agent of the Census Bureau to arrange for obtaining adequate data regarding the deaf in the census of 1900 in this country and devoted large amounts of time to this work at great personal sacrifice. It is not surprising that at the World's Congress of Instructors of the Deaf held in Chicago in 1893, Dr. Bell was held as the man to whom "*more than any other man* not directly connected with the work, we are indebted for the great advance made in teaching speech to the deaf, and in the establishment of oral schools of instruction throughout the country."

Among the honors received by Dr. Bell, some of those which touched him the most were the naming for him of several schools for the deaf.* Among his many honorary degrees, Harvard College in 1896 gave him LL.D. for his scientific achievements and work for the deaf child.

A Pioneer in Eugenics

BELL'S WORK on the eugenic dangers of the enforced segregation of deaf people led him into pioneer work in the general field of eugenics which, throughout his life, continued to be one of his important interests. In 1918 and 1919 he published the results of extensive studies of longevity and of the betterment of the human race by heredity. In 1921 he was made Honorary President of the Second International Congress of Eugenics at New York City. During the last 30 years of his life he carried on continuously breeding experiments with sheep, leading towards the development of a more prolific breed. These experiments are still going on with the original line in Middlebury, Vermont, with encouraging results.

In spite of all these accomplishments, Bell's incessant activity gave him time to apply his genius with profit to other fields. One of the most important of Bell's inventions outside of the telephone field resulted

* See page 236.

directly from the Volta prize. Bell's interest in speech led to the development by the Volta Laboratory of the engraving of wax for phonograph records, applicable to both the cylindrical and flat disk forms. A fundamental patent was obtained on this now generally used type of record. It is of interest to note that one of the original records developed by Bell and his associates, which was deposited at the Smithsonian Institution in 1881 in a sealed package, with instructions that it should be opened in 50 years, was recently played in the presence of Mr. Bell's daughters and of interested scientists.

Another invention of importance was the telephone probe, an adaptation of the telephone and the electric circuit, to determine the location of a bullet or metallic masses in the human body. In recognition of this, and other inventions, the University of Heidelberg gave him the honorary degree of M.D. in 1886.

Bell lends a hand in hauling down one of his big tetrahedral-celled man-lifting kites. A grandson helps out in the foreground

Experiments in Aviation

NOTHING better illustrates Bell's independence of thought than his staunch support of aviation at a time when it was considered so quixotic a subject that Bell risked his scientific reputation in so doing. As Lord Kelvin wrote to Mrs. Bell in 1898, "When I spoke to him on the subject at Halifax, I wished to dissuade him from giving his valuable time and resources to attempts which I believed, and still believe, could only lead to disappointment, if carried on with any expectation of leading to a useful flying machine."

In 1891 Bell contributed $5,000 for Langley's aviation experiments. On May 6, 1896, he saw the successful flight of Langley's steam-driven 16 foot model, which, however, did not carry a man. Speaking of this experience later, he said, "The sight of Langley's steam aerodrome circling in the sky convinced me that the age of the flying machine was at hand."

In 1898, Bell was elected a Regent of the Smithsonian Institution. His enthusiasm for Langley's experiments with small-scale models of a flying machine had much to do with obtaining from the War Department an appropriation of $50,000 to be used by Langley for the development of aeronautics.

Bell (right) watches intently as the DH4 rushes toward him over Baddeck Bay. Rising on steel planes or "hydrofoils" as its airplane propellers give it velocity, the odd-looking vessel (inset in circle) gains speed as its water resistance decreases. It set a 1920 speed record of 71 miles per hour

Langley's full scale model, carrying a pilot, fell into the Potomac on its trial in 1903, and the whole project dissolved in ridicule. However, soon after this the Wright brothers made their epochal flight at Kitty-Hawk, the first man-carrying flight of a controlled airplane. These events further confirmed the abiding interest in aviation of Alexander Graham Bell.

For years Bell had been studying the flight of kites at his summer home, Beinn Bhreagh, in Cape Breton Island on the Bras D'Or. This he considered the best approach to the problem of aviation. By 1901 he was working with a tetrahedral form of kite structure, a form which gave stability. This work was greatly expanded in the following years. Giant kites of multicellular, tetrahedral form were built and flown. In 1907 his huge kite Cygnet I, towed across Baddeck Bay carrying Lieutenant Selfridge, rose to a height of 168 feet.

While Bell's tremendous experimentation in this field was without direct application to aeronautics, indirectly it was of importance. It led Mr. and Mrs. Bell to become patrons of aeronautical research and greatly to advance aviation in this way. In connection with his experimental work, Bell attracted to his home at Beinn Bhreagh a group of talented young men devoted to aviation. In

October, 1907, he entered into an agreement with these men for their joint production of experiments on "aerial locomotion," "all working together individually and conjointly in pursuance of their common aim to get into the air by the construction of a practical aerodrome driven by its own motive power and carrying a man." This organization was named the Aerial Experiment Association, and its work was financed by Mrs. Bell. The Association included Bell, Glenn H. Curtis, F. W. Baldwin, J. A. D. McCurdy, and Lieut. T. Selfridge. Bell was chairman.

The Aerial Experiment Association, during its one and one-half years of activity, principally at Hammondsport, N. Y., made important contributions to the development of aviation. In March 1908, their first machine, piloted by "Casey" Baldwin, made an important public flight, rising 10 feet above Lake Keuka for a distance of over 300 feet. One of the achievements of this flight was a demonstration of the aileron as an improvement over the wing-warping method previously used by the Wrights for obtaining stability. The aileron is fundamental to all airplane construction today. The second machine of the Association introduced the doped fabric which played so important a part as a wing cover through 20 years of the development of flying. The third machine, designed by Curtis, flew so well that it was entered for the *Scientific Ameri-*

Another concept to which Bell devoted interest and study was the condensation of fog to furnish fresh water for men adrift at sea. Here he conducts an experiment at his summer home in Nova Scotia

can trophy for the first public flight of one kilometer, straightaway. The flight was made July 4, 1908, and the trophy won. The fourth machine of the Association used balloon fabric for the wings and proved very successful. In the winter of 1909, McCurdy made repeated flights at Beinn Bhreagh, sometimes doing nine miles at a stretch. The Association was dissolved at midnight March 31, 1909, with a resolution by the members "that we place on record our high appreciation of her (Mrs. Bell's) loving and sympathetic devotion without which the work of the Association would have come to naught."

As in the case of his work on the telephone, Bell's activity for the advancement of aviation was stimulated by a prophetic vision of the future importance of developments in this field. In 1908, asked by the editor of *Century* to comment on proofs of an article by E. C. Stedman entitled "The Prince of the Power of the Air," Bell wrote: "While, of course, the bird is Nature's model for the flying-machine heavier than air, Mr. Stedman is undoubtedly right in looking upon the fish as the true model for the dirigible balloon. It is certainly noteworthy that the dirigible war-balloon of today already approximates the fish-like form predicted by him. He is also right I think in supposing that of all the nations in the world the interests of Great Britain will be most vitally affected by progress in aeronautics. For it is obvious that sea-power will become of secondary importance when air-power has been fully developed throught the use of dirigible balloons and flying machines in war. The nation that secures control of the air will ultimately rule the world."

Bell the Individual

THIS brief description of some of Bell's chief accomplishments gives also an indication of some of his outstanding personal characteristics. He was one of driving energy, insatiable scientific curiosity, independence of thought and individuality of action. As a young man, he was tall, dark with flashing eyes, somewhat frail in appearance. He was described by an observer in 1877 as follows: "Professor Bell is a man of most genial and kindly presence, so courteous and gracious in manner that you could not feel yourself an intruder though you chanced to drop into his room when some private class was under special training. At the same time though his affability sets you at ease, you could not fail to observe that he is one of the busiest of men, so intent upon the development of plans which occupy his life that he has no leisure for visitors who are not interested in his work. He is young, apparently not more than five and thirty (he was just 30) with an unusually prepossessing countenance; very happy in his expression; of pale complexion with jet black hair brushed up from his forehead and pleasant, sparkling black eyes—the face of a man all engaged in his work and finding satisfaction in it."

Later in life, Bell's health became more stable, his frame filled out, his hair became white and his whole appearance impressive and commanding.

Few men are so honored while they live. Bell here stands before a memorial erected in his honor at Brantford, Ontario, and unveiled by the Governor General of Canada in 1917

Bell's code of honor included scrupulous regard for the exact description of his own contributions to inventions or researches and credit to those of others. He was present at the Second Annual Banquet of the Aerial Club of America shortly after the successful flight of the first machine of the Aerial Experiment Association. Cheered to his feet by prolonged applause of this performance, he said, "I really had nothing to do with the success of the experiment. The credit for its success was due Mr. G. H. Curtis, Mr. F. W. Baldwin and Mr. J. A. D. McCurdy. ... In this company of experimenters I must include Lieutenant Selfridge of the United States Army and Mrs. Bell who supplied the capital for the scientific experiments to get the machine into the air."

His appreciation of assistance and encouragement received from others was warmly felt and often expressed in some tangible and suitable way. Though Joseph Henry died before the telephone was well established, Bell saw to it that an instrument was installed without charge in Henry's residence for the use of his family, "in recognition," Bell said, "of the efforts and services of Prof. Henry in the early history of the instrument and who did a great deal to encourage the inventor."

Bell's services to the promotion of science extended far beyond his own researches. From 1898 to 1903, he was President of the National Geographic Society and did much to develop the policy of that Society and of its magazine in the channels which have led to the present tremendous membership and influence. He served as Regent of the Smithsonian Institution from 1898 until his death. In 1890, a

generous gift by him helped start the Astrophysical Observatory of the Institution and in 1894 he brought the body of James Smithson, founder of the Smithsonian Institution, from Genoa to Washington

Bell's Many Honors

HONORS CAME to Bell in great number. Some of these have been mentioned in the discussion of his achievements. He received a large number of honorary degrees from universities in America, in the British Isles and in Germany. He was elected a member of the National Academy of Sciences in 1883. He was made an Officer of the Legion of Honor of France in 1881. He was awarded a medal by the Louisiana Purchase Exposition in 1904, the John Fritz Medal from a group of national engineering societies in 1907, the Elliott Cresson Medal from the Franklin Institute in 1912, the David Edward Hughes Medal from the Royal Society, London, in 1913; the Thomas Alva Edison Medal by the American Institute of Electrical Engineers in 1914, and the Civic Forum (New York) Medal in 1917. In 1917 the Governor General of Canada unveiled a Bell Telephone Memorial erected in his honor at Brantford, Ontario, in the Alexander Graham Bell Gardens and dedicated the Bell homestead and grounds as part of the public parks system of Brantford. In 1920, his native city of Edinburgh elected him a Burgess and a Guild Brother of the city and conferred upon him "The freedom of the city of Edinburgh in recognition of his great achievement in the solution of the problem of telephone communication and of his brilliant and distinguished career as a scientist." This was an honor which deeply touched his heart.

Early in his professional work Bell determined to become a citizen of the United States, taking out his first papers in 1874 and receiving his final papers in 1882. He was immensely proud of his American citizenship, which, as he stated, was his by choice rather than by accident.

Bell's Personality

IN THE LATER YEARS of his life, Bell spent more and more time at his summer estate, Beinn Bhreagh, in Nova Scotia. Here, on August 2, 1922, he died. Here he was buried on the top of a mountain in a tomb cut out of a solid rock, with the epitaph, "Died a citizen of the U. S. A." During the ceremony, every telephone on the continent of North America was silenced in honor of the man who had given to mankind the means for direct communication at a distance.

Not only did Alexander Graham Bell leave the telephone as a perpetual memorial to him but the influence of his personality remains strong on those who knew and loved him. Even now, 20 years later, a scientist who for many years knew him well, writes, "The fact that he never spoke disparagingly of others was a remarkable trait, the value of which nowadays I appreciate more than I did when he was alive. I miss his personality more than that of any other human being who has come and gone in my life."

A New Medium of Transmission Is Taking Its Place Beside Open Wire, Cable, and Coaxial Systems as a Conveyer of The World's Telephone Messages

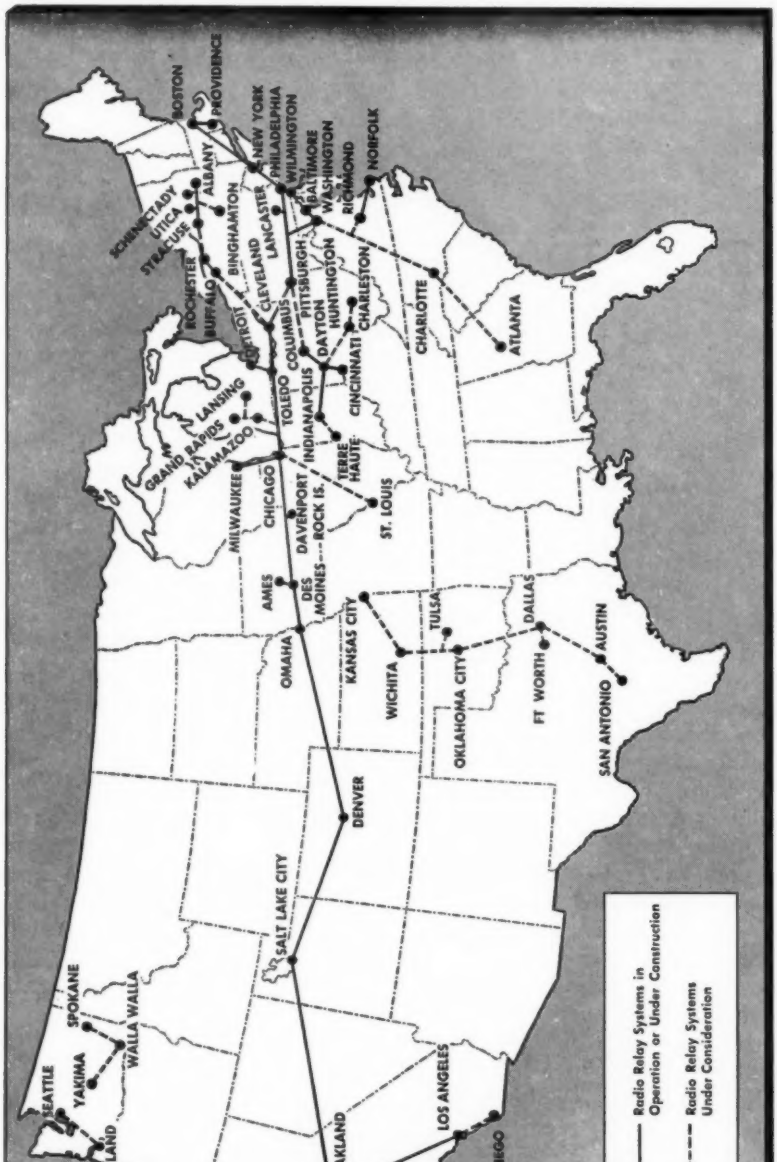
Spanning the Continent By Radio Relay

Richard D. Campbell and Earl Schooley

THE TELEPHONE ENGINEER'S vision of bundles of telephone circuits or of television circuits spanning the country by radio is now close to realization. A radio system is being built overland between New York and San Francisco which will be capable of handling hundreds of telephone messages and several television programs. Already it is being used from the East Coast to Omaha—1,300 miles—and in 1951 the new system will push westward another 1,700 miles from Omaha to link the East Coast and the West. Over one hundred telephone circuits—only a small part of its ultimate capacity—are planned for operation initially in the section west of Chicago.

Completion of the transcontinental system will make it possible for the first time for hundreds of people to talk and for millions of people to see by radio from coast to coast. This is indeed a momentous engineering achievement. It brings to the public the benefits of the coördinated research, development, manufacturing, construction, and operating program of the Bell System in further harnessing the laws of nature and developing the use of the radio spectrum, one of the natural resources of the country, to provide improved communication facilities to the nation.

Several wire routes, two of which are cable, already connect the East and West Coasts. But additional facilities are needed, and radio relay is being used for this new transcontinental system because it affords an economical means of providing them. This does not mean that radio relay will replace existing means of



Bell System radio relay routes in operation or under consideration

wire communication. On the contrary, wire facilities will continue to provide the bulk of the nation's communication facilities for the foreseeable future. Radio relay will be used in preference to other forms of communication where this appears to afford definite advantages. The decision will be based in each case on a consideration of all the factors involved, including cost, reliability of service, and performance. This long-run policy will thus continue to insure the telephone-using public of the best possible service at the lowest possible cost.

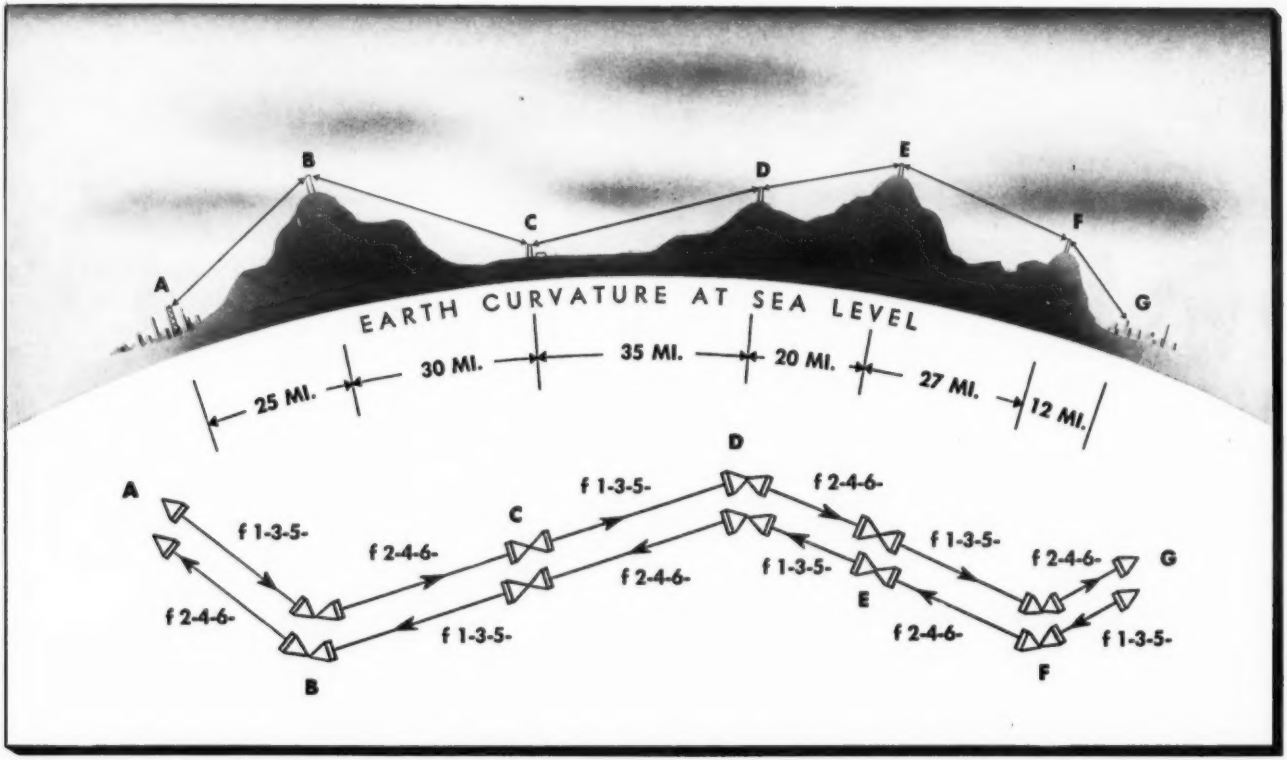
Widening Radio's Field

UNTIL quite recent years, radio has proved useful in the Bell System principally as a means of communicating with ships and other mobile units and with points that could not readily be reached by wires; but the development of new radio relay systems has greatly broadened its field of use. Wires and radio have in common, however, the fact that research and development over the years have increased the capabilities of each to carry more and more telephone circuits. Forty years ago, it was difficult to make even one speech channel operate successfully over a pair of wires for any great distance, and radiotelephony was just entering the experimental stage. Today, telephone conversations are being "stacked up" sixteen deep on a pair of wires on a pole line, cable pairs carry a dozen messages, and a pair of coaxial tubes may transmit as many as six hundred long distance conversations at one time.

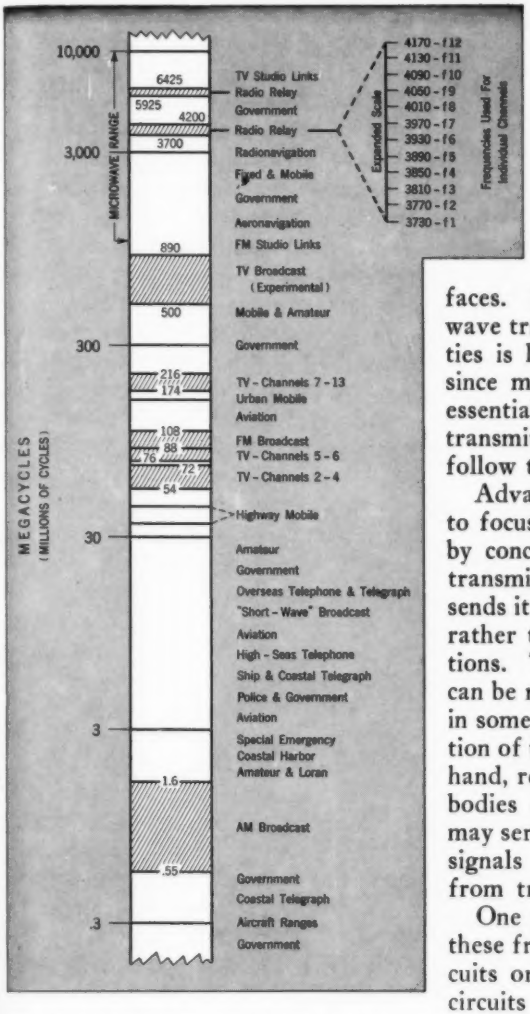
The radio relay systems now taking their place in the telephone plant alongside those facilities are the result of similar growth in the radio art. A radio system placed in operation in 1920 between Long Beach and Catalina Island, Cal., produced one telephone circuit. Today, a radio system from Los Angeles to Catalina carries eight speech channels. Commercial overseas radiotelephone service was first opened in 1927, between New York and London, with one speech channel per radio system. Today, overseas radio systems handling as many as three or four telephone circuits are in use, connecting us with some 90-odd countries. A radio system installed in 1941 to span the mouth of Chesapeake Bay has grown from the initial ten to 22 telephone message channels.

The radio relay system being built across the country will be able to carry hundreds of telephone circuits, yet there will be no pole lines or cables to construct and maintain across mountains, rivers, and plains. Instead, radio relay stations are constructed at intervals of about 30 miles on the average, and maintenance will be needed, therefore, only to keep the structures and the equipment at these stations in proper condition.

The newly developed radio relay system operates in the 4,000 megacycle range (4,000,000,000 cycles), where the corresponding wave length is extremely short. It is, actually, about three inches long, as compared to wave lengths of about 1,000 feet for frequencies in the middle of the standard broadcast band (550–1,600 kilocycles). Waves of this length are known as microwaves, and they have many characteristics similar to light. These characteristics prove



The upper diagram represents a section of radio relay route, showing stations located to permit line-of-sight transmission. The lines between towers indicate direct radio paths, the span length being determined by considerations of attenuation, noise, and fading. Below is a corresponding map of the route, showing the two directions of transmission on separate beams. The route is zigzagged to avoid possible interference between sections using the same frequencies



The location in the spectrum of the frequencies used for Bell System radio relay transmission is shown above with respect to certain other radio services. The individual channel frequencies are indicated on the expanded scale at the top right of the diagram. They are identified as f1, f2, f3, etc., to correspond to the frequencies shown on the diagram opposite. Use of a logarithmic scale is essential here, since a legible linear scale including the same information would be many feet long

useful in many ways, but they also complicate the design and operation of a radio relay system in certain respects. The microwaves can be focused into a beam in the same way a searchlight sends a beam, and they can be reflected from relatively flat surfaces. The range of reliable microwave transmission with present facilities is limited to line-of-sight paths, since most of the energy travels in essentially straight lines from the transmitting antenna and does not follow the earth's curvature.

Advantage is taken of the ability to focus the microwaves into a beam by concentrating the energy from a transmitter into an antenna which sends it to a particular radio receiver, rather than scattering it in all directions. The fact that such frequencies can be reflected has been made use of in some instances to change the direction of the radio beam. On the other hand, reflections from salt flats, large bodies of water, or treeless plains may seriously interfere with the radio signals traversing the direct path from transmitter to receiver.

One of the basic reasons for using these frequencies is that television circuits or large numbers of telephone circuits need a very broad frequency band—three or four million cycles or more in width. In order to find space in the spectrum where bands several million cycles wide could be obtained, it was necessary to turn to the microwave frequencies.

Selecting a Route

A SMALL ARMY of people must coordinate their efforts in order to es-

tablish a radio relay system. Once a decision is reached to build such a system, engineers study the topography of the ground, using the best maps available, and pick a tentative route.* Since the earth's curvature must be taken into account in finding line-of-sight paths, it is natural to seek elevated sites for repeater stations in order to extend the distance between them and thus minimize the number of stations required. Hilltops are likely to make good repeater station locations. Elevations are desirable that will permit sending the radio frequencies about 30 miles on the average.

* See "Radio Relay and Other Special Buildings," MAGAZINE, Spring 1950.

The steel skeleton tower supports the antennas on its summit, and carries the connecting "plumbing" to them; the house contains the radio equipment, the power supply, and the emergency generator

Remembering that the radio equipment has to be cared for, a site which is inaccessible during the winter months will probably not be satisfactory, despite any other advantages it may have. Remembering, too, that microwave frequencies can be reflected, relatively flat sections of the earth's surface—including water-covered areas—must be avoided or else crossed in such a way that, if reflections do occur, no serious harm will be done.

When the map work is complete, crews go into the field to study the locations selected from the maps. In some areas, the only maps available are based on surveys made more than 60 years ago. In several cases, hills appearing on these maps were found, on field check, to be incorrectly located. Locations picked from maps were often found to be already occupied by farm buildings or, in some instances, by radio stations.

Sometimes hilltops with good access, power supply, and other advantages cannot be used because higher hills, trees, or city buildings are in the line-of-sight path, or because of restrictions imposed by local or federal laws. Even though hilltops are used, towers are required in some locations to provide an additional 200

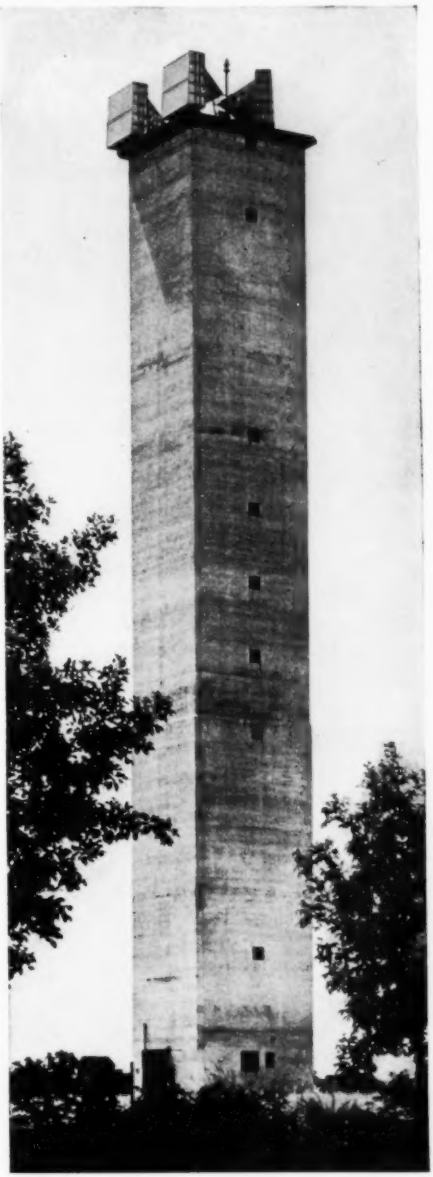
feet or so of height which may be necessary for reasonably long line-of-sight paths to the next relay points.

Tentative sites for the antenna towers are picked and temporary towers are erected. These towers are used to support special radio test equipment to check the path to the next adjacent site. This check may indicate that the tentative site selected is not satisfactory because of bad reflections, or because the path is obstructed by a hill or by a large structure, such as a water tank. The tests may also indicate that shorter or taller towers are required than the preliminary review seemed to indicate. Other tests are made on the soil, to determine the nature of the tower foundation required.

Since a shift of even a few hundred feet in location of a relay site may affect the tower height and location of the two adjacent repeaters, no sites are purchased until there is reasonable assurance that all sites on a route are satisfactory.

Once the sites have been secured, bids are obtained from contractors for the foundation and erection work at each location. Roads must be built, power brought in, and other facilities provided which are not generally at hand in the remote locations usually chosen for radio relay points.

About ten months later, if all goes well, the buildings and towers will be complete and the radio equipment and antennas will be on the ground ready for installation.



The antennas are on the top and the emergency generator is in the bottom of this concrete building; the radio equipment and power supply are inside, about half-way up. The airplane warning beacon required on most such towers is visible between the antennas

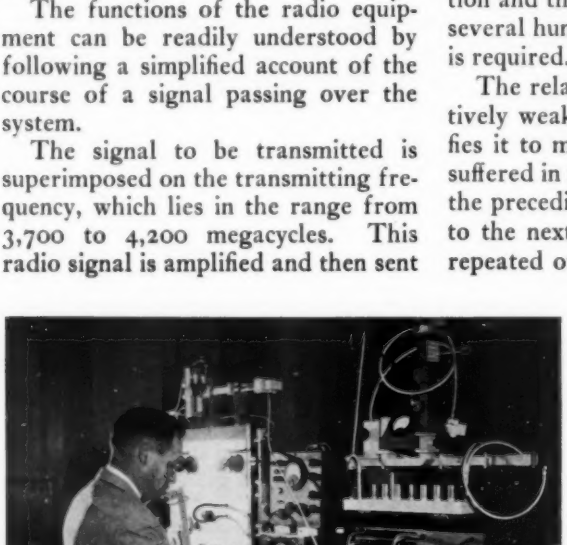
Using Microwave Frequencies

THE EQUIPMENT USED in the radio relay system consists of the same basic elements as are used for other Bell System radio services. These include radio transmitters, radio receivers, and antennas. The main differences between the radio relay equipment and that used for the other systems are the use of microwave frequencies, the new techniques involved in the apparatus design, and the ability of the equipment to handle wide frequency bands.

The functions of the radio equipment can be readily understood by following a simplified account of the course of a signal passing over the system.

The signal to be transmitted is superimposed on the transmitting frequency, which lies in the range from 3,700 to 4,200 megacycles. This radio signal is amplified and then sent to an antenna, where the energy is concentrated in a narrow beam directed through space toward the first repeater station along the route. Since the energy is concentrated, it is not necessary to use the millions of watts which would be required if the energy were scattered in all directions, as in radio broadcasting. Instead, the actual radio power output is only half a watt, or about the same amount of energy required to operate a flashlight bulb. Yet to obtain the power to provide adequate amplification and this amount of radio energy, several hundred watts of input power is required.

The relay station receives the relatively weak microwave signal, amplifies it to make up for the loss it has suffered in spanning the distance from the preceding station, and sends it on to the next station. This process is repeated over and over again at successive repeater stations located at intervals along the desired routes. A signal transmitted over the entire system between New York and San Francisco will, incidentally, pass through 105 relay stations.



A Bell Telephone Laboratories engineer conducts experimental work on a transmitter-modulator unit of radio relay equipment, shown at the upper right

At the distant terminal of the radio relay system, the signal, after amplification, is restored to its original form. If it is a television signal, it is ready for delivery to the broadcast station. If the signal consists of a group of telephone circuits, it must be con-

nected to equipment similar to that used in coaxial and other carrier systems, which performs the feat of unscrambling each telephone conversation from the others before delivery over individual circuits to the customers' telephones.

This account has traced the course of a signal transmitted over a radio relay system in one direction only. For two-way service, such as is necessary with telephone communication, equipment must also be provided for transmission in the reverse direction. The traffic on many routes may require the installation of additional radio equipment for the broad-band channels which would be necessary to handle more bundles of telephone circuits or additional television programs.

A single radio relay antenna may transmit as many as six broad-band channels in one direction. Another single antenna may receive the same number. Hence, only four antennas in all—one transmitting and one receiving antenna side by side facing in one direction and a similar pair facing in the opposite direction—will suffice at each radio relay point along a route equipped to handle six broad-band channels in the two directions.

If a branch route takes off from a relay station in a different direction, an antenna is also needed for transmitting toward and another for receiving from the new direction.

Microwave Transmission

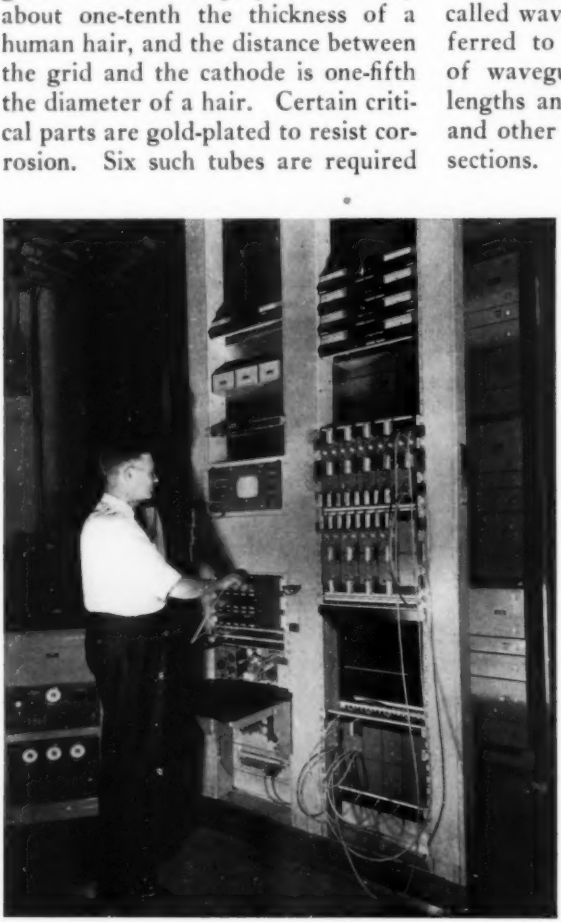
EVERY ADVANCE in telephone science and telephone service represents foresight, long-range planning, guided and coördinated attack upon a problem, and a practical solution. In this pattern, radio relay is the outcome of long and fruitful effort by the Bell Telephone Laboratories, and its installation bespeaks the utmost skill and manufacturing precision by the Western Electric—the Bell System's division of manufacture and supply.

Here are the elements of the close-spaced microwave triode. The upper and lower items at the right are the tube base holding the heater leads and the tube envelope; the rest are components. The inch scale indicates the small size of the tube

A better appreciation of the development and manufacturing effort required in producing the radio relay equipment can perhaps be obtained by considering a few of the components involved. Take, for example, the close-spaced microwave triode (Western Electric Type 416A microwave vacuum tube), which is the very heart of the equipment. It is used to generate and amplify the extremely high frequencies employed for transmission. This tube, which is about

the size of an English walnut, is the same in principle as any ordinary three-element vacuum tube having a cathode, grid, and plate. The placing of these elements in the extremely small space required to make the tube work at these frequencies is a triumph of design and manufacture. The grid structure employs wire only about one-tenth the thickness of a human hair, and the distance between the grid and the cathode is one-fifth the diameter of a hair. Certain critical parts are gold-plated to resist corrosion. Six such tubes are required for each one-way channel at each relay station.

At microwave frequencies, the energy is easily radiated, and therefore ordinary wire connections cannot be used for guiding these frequencies from one place to another. It has consequently been necessary to guide the energy by means of pipes or tubes, called waveguides, and frequently referred to as "plumbing." Sections of waveguide are made in various lengths and shapes, including elbows and other bends, twists, and straight sections. A cross-section is about half the size of a playing card. The various sections are bolted together by means of flanges. Dents and other deformations of the waveguide and flanges must be guarded against because, even when relatively minute, they are likely to result in transmission irregularities.

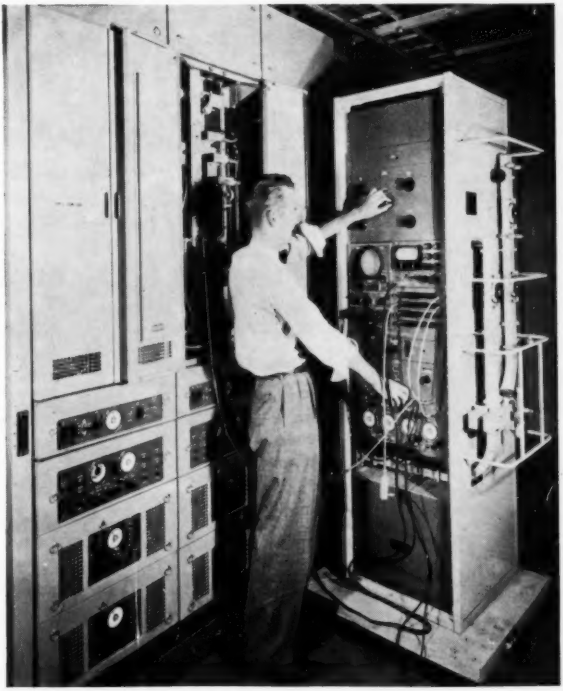


This man is watching a video monitor in a patching bay at a radio relay station where a branch connection is provided to a television broadcasting station. A test console may be seen at the left

Microwave transmission would not be practicable without highly directive antennas, and these too deserve particular consideration. The type normally used in the radio relay system is made of metal, and acts in the same manner for microwave frequencies as a glass lens does for light waves. For this reason, it is commonly referred to as a lens antenna. By the use of

such an antenna, the microwave frequencies can be focused into an extremely sharp beam. Lens antennas are used for both transmission and reception. If non-directional antennas were used, the output of the transmitter would have to be increased to about 50,000,000 watts of power, instead of the one-half watt used with the lens antennas, in order to produce the same transmission effectiveness.

Equipment has been developed for use at the repeater stations and at special maintenance centers to assist in determining the overall performance of the radio equipment during routine testing or to locate the source of troubles which might develop.



The three large cabinets at the left—one with its door open for testing—are radio transmitter-receiver bays. The equipment in each serves as a relay station to receive, amplify, and transmit one broad-band channel in one direction. The test bay with which the man is working is used to locate trouble and to make routine checks of the equipment

The reliability of service over the radio relay system can never be better than the reliability of the power supply from which it operates. For this reason, the equipment is operated from storage batteries. Commercial power is used as the primary source of energy at most stations. However, to insure continuity of service, a standby gasoline or diesel engine generator, capable of automatically taking over the load in case of a failure of commercial power, is installed at each station.

Rectifiers which provide the required current supply for the batteries are installed in duplicate, and if one fails, the other takes over automatically. The storage batteries are capable of carrying the load for six to eight hours, which is generally time enough for a maintenance man to get to a station if something should go wrong; and in some locations difficult of access, a larger battery is used which is capable of carrying the load for as long as 24 hours, further insuring continuity of service.

Since the repeater stations are de-

This radio relay station, under construction on Mt. Rose, Nev., is nearly two miles above sea level, the highest elevation of any station in the entire transcontinental system

signed for unattended automatic operation, a control system is used to provide information at special maintenance or alarm centers concerning the operating condition of the individual stations. The system produces a visual and an audible signal at the alarm center when trouble develops at an unattended station. Upon receipt of such an alarm, 42 different alarm conditions at the unattended station can be checked from the alarm center. These conditions range from an open door at the station to failure of a rectifier or the failure of an aircraft tower warning light. The alarm center is thus apprised promptly of unsatisfactory conditions at the unattended stations, and remedial action can be taken.

In a long radio relay system, the maintenance work must be carried on from regional maintenance centers located at strategic places having access to the individual stations along a section of route usually ranging from 100 to 300 miles in length. A special telephone circuit is provided to interconnect the individual stations in each of these sections with their associated alarm and maintenance centers. To facilitate coördination of the maintenance work in the individual sections, another circuit is provided which interconnects only the terminals, the main stations, the alarm centers, and the maintenance centers of an entire system—such as the one between New York and Chicago. These circuits are usually provided by wire, but separate radio facilities have been used in a number of cases to connect relay stations at remote points.

Problems and Capabilities

THE BELL SYSTEM is now operating some 8,150 channel miles of broadband radio relay systems. Seventy percent of this mileage is provided by the use of the newly designed microwave equipment, and most of this was placed in regular service in September of 1950. All of the radio relay facilities at present in service are being

used commercially for television transmission. The experience to date with the newly developed equipment confirms the expectation that this system can transmit present-day television signals over very long distances with excellent results. Test pictures transmitted twice around the New York-Chicago system, a distance of approximately 3,300 miles, can easily be mistaken for pictures which have been transmitted only over local pick-up facilities.

As may be expected with any new development, some equipment difficulties were experienced during early tests of the microwave radio relay systems. Unexpected sources of noise and transmission irregularities had to be tracked down and minimized or eliminated. Equipment troubles were studied and the necessary corrective action was taken. Plenty of coöperative effort made it possible to place the system in regular operation on schedule.

On the operating side, men had to be trained in large numbers to assume the maintenance and operating duties involved in the use of this new form of communication system. Here, too, the successful operation of the systems now in use speaks well for the manner in which this program was carried out, and for the hard work, loyalty, and skill of the plant personnel.

Tests made on the New York-Chicago system give further support to laboratory tests proving the practicability of carrying large groups of telephone circuits over transcontinental distances. Needed telephone circuit facilities are to be provided by the use of radio relay systems on a number of routes during 1951—including service over the Chicago-San Francisco route. Present plans contemplate that by the end of 1951 the total channel miles of broad-band radio relay systems in operation will have increased to nearly 25,000. Of these, about one-third will be equipped to provide a total of about 800,000 circuit miles of telephone circuits.

There are still things to learn about radio relay, and of its future no man can speak with certainty. But already radio relay has shown that it will have a vital part to play in meeting the communication needs of our nation, in peace or in war. The thousands of miles of radio relay now in service and being constructed will take their place alongside open wire, cable, and coaxial systems as a conveyor of the world's messages.

A Library Shelf

SEVERAL ROWS of bright green boxes stand handy on a shelf by the entrance to one of the large reading rooms in the New York Public Library. Many a scholar headed for serious investigation into the War of Jenkins' Ear or into sources on the life of the Aga Khan notices those boxes, and stops, looking as if stopping were the last thing in the world he intended to do. He takes a paper-bound book from one of the boxes, then settles down happily in a near-by seat. Serious research can wait. The scholar is going home again, back to the town he came from twenty years ago or more, by courtesy of the home town telephone directory.

THE LIBRARY now has a copy of almost every telephone directory in America. Anyone who wants to know Frank Glasgow's number in Sweetgrass, Mont., or Joe Whaley's number in Snow Hill, Md., need only stop in. A call to Information on the phone will produce the same thing, of course, but that's business. The pleasure is in taking up the directory for the long-unvisited home town and in seeing what's happened there, as the telephone directory shows it.

For one thing, the town has grown bigger. The directory of 1920 was a small volume. Today it has expanded in all directions and is an inch thick. It mentions a lot of new suburbs that didn't exist thirty years ago, places tagged with the color-drained names that are the unique pride of suburban realty developers: Hillcrest, Meadowlawn and Brookside. Amid this rocketing expansion some landmarks remain: Stolzfuss' grocery, where the old man probably still refuses to sell cigarettes to 12-year-olds, and Potteiger's drug store with its marbly soda fountain and the jars of colored water in the window. Not even the phone numbers, dimly recalled, have changed. Not so, with people. There used to be a clan of Shollenbergs, a family of six or seven brothers, that filled a house on their frequent reunions. The name does not appear in today's directory. A fair number of people have moved, to the suburbs or to the outskirts of town. Others are vanished, to the larger cities or perhaps to the cemetery on the hill. (Caretaker's residence: 3346–J.)

THE LIFE STORIES of some of the people still at home can be read in the directory. Joe Dunkleberger, one of a family of twelve kids, who had to quit school at 11, is still in town. His phone is listed with an address in the snootiest suburb and his insurance office is in the new Dunkleberger Building. Carl Brown, who once hoped to get to sea to escape the most climbing ivy of mothers, still resides in the same house on South Fourth Street, now in the factory district. His mother always said she would never give up that house as long as she lived. Snooky Jones, maker of gray hair for teacher and truant officer in all eight grades, is now listed as Rev. William D. Jones, D. D. And Mary Elizabeth Hettinger, once the prettiest, richest and most marriageable girl in town, is listed as "Miss" and resides at the Normandie Vista Apartments. She never could decide which beau she liked best.

THE LIBRARY'S COLLECTION of telephone directories is a mass of prime source material if the historian first knows a little about the sources. The earnest ladies who work daily in the Local Room at the Library, chasing down the twigs and branches of genealogical trees for those still concerned about their ancestors, might well wish for a collection of something like those directories for the years 1620–1850.

For those books show two historical facts absolutely beyond argument: that on a certain day so-and-so lived at such-and-such an address and was solvent enough to pay a phone bill.

From the *New York Times*, by permission

Visual Presentation Is One of the Means through Which The Bell System Meets Its Obligation to Tell Users about The Telephone and How It Serves the Nation

Showing Our Customers the Elements of Good Service

Walter V. Brown

MEETING more than eleven million folks face to face!

That was the job the Bell System carried out in 1950 to *show* customers what makes good telephone service. It was done at fairs, trade shows, open houses, and museums. And it follows the axiom of this business that "The more that customers know about the telephone, the more satisfactory will be their use of it."

The business believes it is obligated to tell the public about its instruments and equipment, its personnel, its policies and objectives—about the innumerable aspects of America's largest single enterprise, which provides Americans with the best telephone service in the world.

The Bell System uses many channels of information to reach its customers. The best known of these are newspaper and national magazine advertising, the Telephone Hour and allied radio programs, and Bell System motion pictures.

The advertising and radio programs are effective with many thoughtful people. Systematic measurements tell us this. And during 1950, the Bell System motion-picture audience totaled almost 50 millions.

There are, in addition, many millions of customers to whom visual education programs have a special appeal. They are the folks who "go places" in crowds—to ball games, fairs, museums, trade exhibitions—any place there's a show going on. Such people are interested in their own affairs, not in the telephone business. Yet, as customers, they are entitled to information about the business. These individuals are best approached on a face-to-face basis. And it is to this audience that "displays" or "visual presentations" are directed.

Open House "Affairs"

PEOPLE who go with the crowd expect either to be entertained or to learn something. Consequently, there are two main ingredients of audio-visual programs: the first is sufficient entertainment to get the second across—the second being an interesting story.

It is entirely possible to provide just entertainment—a good time without a serious message. The Bell System has neither the time nor the desire for this. Its objective is to give information about the business—and information can be interesting if it is given in an entertaining way.

This is well illustrated in the familar telephone company "open house." Here the public is encouraged to visit telephone central offices, to see and learn how the telephone business operates. Americans are very curious about how things work —whether it's a deep-freezer, a new car, or the telephone. The telephone company "open house" has a similar attraction for many townspeople. In 1949 nearly a million persons visited Bell System buildings at 500 separate "open house" events. The Korean situation created a need for caution

Watching the calls go through. The operator's job holds a fascination for central-office visitors, and tours of a telephone building during an "open house" event are often so arranged that people may linger for a few minutes after the demonstrator's talk is finished

A cable splicer at work—upper left—is a sure-fire drawing card at a fair or "open house." This picture was taken at the Wisconsin State Fair at Milwaukee last Summer, where 90,000 people visited the telephone exhibit

with open houses—for security reasons—but about the same number of visitors attended in 1950.

There are times when it is just good business to hold open house, such as on Business-Industry-Education Day or a similar occasion, when many establishments in a town open their doors to the entire populace. The usual reasons for holding an "open house" are much the same, however, as those that control Bell System participation in fairs or trade shows. But whatever the occasion, there should be a specific telephone story to bring to the attention of the visitors.

THERE ARE many good reasons for inviting the public to an "open house," and at least one should be evident to visitors. In other words, the event is most successful, from the company's standpoint, when definite themes are emphasized. These might include such matters as the kind of people who work in the telephone business and those who manage it, working conditions and the opportunity for new operators, or the significance of a new central office and the company's contributions to the community's welfare. Of broader scope would be topics such as the value of telephone service, the need for adequate earnings, and the Bell System's policies and objectives. If there is a local operating problem, it should receive due notice.

There is no magic formula for "open houses." They can be simple in scope or quite elaborate. The main characteristic is that visitors go to an "open house" because they want to be there. They are in a receptive mood. They are apt to be friendly. They are like guests in one's home, and react warmly when treated that way. They meet telephone people face to face, and find that they are

good neighbors—like themselves. Small wonder, then, that studies show a much more favorable attitude toward the telephone company after a central-office visit. A guest in one's home should always leave as a friend —and these generally do.

A near relative of the "open house" is "family night," when relatives and friends of employees visit the telephone office. Central office visits by school classes, service clubs, and other groups also fit in this category. Recently a modification was used with great success by one Bell company when personal invitations were issued to individuals in special groups—clergymen at one time, educators at another, and groups of labor union officials at another. These people were greatly impressed by the sincerity of the company management and the working conditions they found. Labor leaders commented afterwards that—

"It is a surprise to see your plant men working in white shirts and ties" . . . "I was impressed by general working conditions and hours worked" . . . "I have been favorably impressed by the efficient operation of your business . . ."

Demonstrating Progress

IN THE SPRING OF 1949, a new type of demonstration appeared on the Bell System scene. It was appropriately called "Looking Ahead with the Bell System," * and among its features were working units demonstrating operator toll dialing straight through to the distant telephone, automatic message accounting, and radio relay transmission. Also shown were new vacuum tubes, an advanced type of telephone, coaxial cable, synthetic quartz crystals, and the transistor. Since its initial showing at the annual Stockholders' Meeting on April 20 of that year, it has been exhibited by ten Bell System Companies in 13 major American cities.*

"Looking Ahead" was designed to do just that—to look ahead with investors, customers, and employees—by inviting selected community leaders to visit the demonstration. Ninety-seven thousand such guests and 58,000 employees have seen it at telephone company locations so far. Capable telephone men and women act as guides or narrators, creating a pleasing impression in every case. Usually, the company president or another officer talks to each group, outlining the Bell System's plans and the role of his own company in the community.

On every hand, visitors continue to comment enthusiastically. They say the demonstration is more than merely informative. Employees derive stimulus from the broad picture of the future and the part each can play in the over-all job. Stockholders acquire confidence in the growing opportunities of the business. Telephone users respond to what the future promises and the way telephone people go about the job of fulfilling those promises.

Hundreds of letters have been received by the Companies, lauding "Looking Ahead." News stories and editorials have been numerous.

In every city, government authori-

* See "Looking Ahead with the Bell System," MAGAZINE, Spring 1949.

* New York, Washington, Detroit, Lansing, Cleveland, Columbus, Boston, Philadelphia, Pittsburgh, St. Louis, Springfield, Chicago, Los Angeles.

ties were invited, quite naturally, along with other civic leaders. At Washington, Federal government representatives in many branches were guests of the telephone company. Major General S. B. Akin, Chief Signal Officer, Department of the Army, was so impressed by the exhibit that he ordered a similar one to tell the story of Signal Corps operations, and it too is a marked success.

Major Fairs

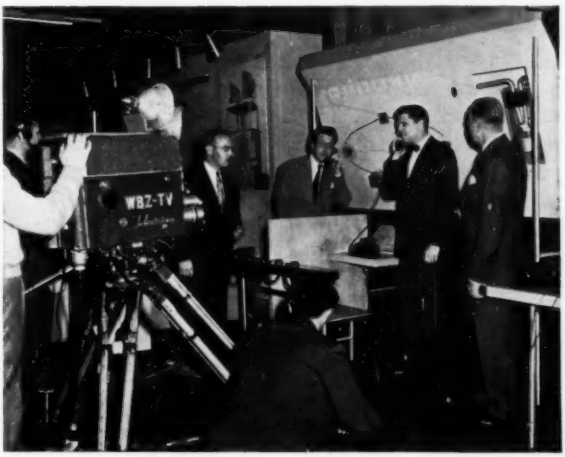
LAST SPRING, a major fair loomed on the horizon—the Chicago Lake Front Fair. The Bell System had not planned to take part, but when the Fair's director saw the "Looking Ahead" demonstration as exhibited in Chicago, he declared it "a perfect example of American free enterprise, and exactly what we need at the Fair!"

Although "Looking Ahead" had been designed for small and selected groups, it was found possible to modify it for a mass audience. At the last minute, it was decided to do so under the joint auspices of the Illinois Bell Telephone Company and the Long Lines Department of A. T. & T., and the Western Electric Company.

Agreement to participate was reached only 29 days before the Fair opened its gates. In that period, a building was constructed, guides were trained, and the exhibits were remodeled. In order to install equipment, the inside of the structure was completed before the outside. The exhibit opened on time.

THE LAKE FRONT telephone exhibit was called "The Bell System Presents . . . The Telephone of Tomorrow." Choice of demonstrations and individual exhibits was carefully evaluated in order to show convincingly how the industry has kept pace with the parade of American achievement. From "Looking Ahead," the operator toll dialing, radio relay, and automatic message accounting demonstrations were selected.

Because of their universal appeal, certain other audience participation exhibits were chosen to round out the show. These included the voice mirror, an overseas call display, test-your-hearing booths and time and weather booths. The "Telephone of Tomorrow," the new 500-type set, was displayed on a special counter.



When "Looking Ahead" was displayed in Boston, it was also televised on an hour-long program

This view is inside the telephone exhibit building at Chicago's Lake Front Fair last Summer. At the left is a display of automatic message accounting equipment, and a new type of telephone is on a counter at the right

The factors of interest that caused the Fair's director to want this telephone exhibit have been amply borne out. It was the hit of the Fair, attracting over a million persons—77 percent of all visitors. Part of the reason for this large attendance was a location near the main gate. But the chief cause is the exhibit's tremendous popular appeal that brings people back again and makes them urge their friends to see the show. One suburbanite wrote:

"Your entire exhibit was built around the idea of permitting the public to 'Touch' and 'Listen.' As we stood back and watched the reactions of the people as they entered the building, we couldn't help but feel that through your efforts, a closer bond was immediately established between strangers, as they laughingly listened on the earphones . . ."

Some of the attendants had worked on "Looking Ahead" when it was shown at the Chicago telephone building. Others were added for the Fair. All were carefully selected and trained, and the excellent job they did of representing the Bell System may be illustrated by two examples.

A well-dressed, elderly man stopped an exhibit floorman and said, "Excuse me, I know this is an unusual question, but please tell me—where do these girls and men [demonstrators] go after the Fair is over?"

The floorman explained that the employees working at the Fair would eventually go back to their regular jobs.

Pointing to a girl at the coaxial cable exhibit, the visitor inquired, "What's her regular job?"

The floorman explained she was a

service representative in the Commercial Department.

"That's marvelous," said the visitor. "These men and women seem to know all about all these exhibits and they answer questions very intelligently. I am very interested to know that you have such efficient employees . . . you see, I'm a modest shareholder of A. T. & T. stock."

Another visitor to the Fair approached a girl narrator and asked if she were a long distance operator. He said he'd never met one, and wondered if they looked like "The Voice with the Smile."

The narrator said she was not an operator; but she took him over and introduced him to a long distance operator who was then on duty at the demonstration switchboard.

Said the gentleman: "You *do* live up to your advertising."

When "Looking Ahead" was exhibited at the Texas State Fair at Dallas to 370,000 people, a Baylor University student majoring in speech was attracted by the attendants' speaking qualities. Commenting on them, he asked, "What, for example, is the telephone job of that girl?" "That girl" was, it turned out, an elevator starter.

A Historic Fair

FAIRS AND TRADE SHOWS are not new in the commercial world. Historically, fairs have existed since medieval times, when they were started at the scene of religious gatherings. But gradually the needs of the crowds attracted merchants, and trade began to appear. The last century has seen the emergence of the exposition and trade show, along with the fair.

Most Bell System Associated Companies participate in State and County Fairs. At these, and at trade shows, the telephone company takes its story out to the public. The companies participated in 105 fairs alone in 1950, with an estimated attendance at telephone exhibits of 4,150,000 people. The messages they convey follow the pattern of open houses, and vary according to the company, community, and locale.

At fairs, in particular, the crowd seeks entertainment as well as enlightenment. The fact that 77 percent of the Chicago Fair's paid attendance—or 1,321,000 people—visited the "Telephone of Tomorrow" exhibit is indicative of the Bell System's skill in blending the two elements.

It is nearly 75 years since the telephone first received public recognition at an exposition: the Philadelphia Centennial, held in the Summer of 1876. Here Alexander Graham Bell, the telephone's inventor, displayed an early model of his "speaking telephone," and here occurred the famous encounter between Bell and Dom Pedro, the Emperor of Brazil. The emperor was inspecting the exhibits, accompanied by the judges of the exposition, when he encountered Bell, whom he had known through his educational work for the deaf. Dom Pedro asked what Bell was doing there, and the latter described his invention and invited His Majesty to test it out. It was the emperor's incredulous exclamation of "My God —it talks!" which attracted the attention of the judges to what one of them later declared was the most wonderful thing he had seen in America.

Just 74 years later, the Brazilian consul at Chicago telephoned to Rio de Janeiro, Brazil, from the telephone exhibit at the Lake Front Fair, while ten hard-of-hearing children from Chicago's Alexander Graham Bell School listened in. The call was answered—oddly enough—by a man named Bell: Mr. W. G. Bell, president of the utility company which provides the telephone service there.

While that coincidence was prearranged, it is nonetheless a fact that, since the Paris Exposition of 1889, there has been a telephone exhibit at every World's Fair, to display to visitors from all the world the evidences of the progress of telephony in America.*

Scientific Museums

MUSEUMS of science and industry are another source of telephone information for crowds of people.

The basic idea behind museums is as old as man's thirst for knowledge. Over the years, museums have become storehouses of information men

* See "Some Historic Telephone Exhibits," Quarterly, July 1939.

This display in the Franklin Institute in Philadelphia is devoted to the telephone. In the foreground are shown transitors, laboratory-grown crystals, and items of Western Electric Company manufacture. The panels in the background are devoted to problems of transmission and switching

wanted. Today, millions of children and grown-ups go to museums of science to learn about nature's phenomena. One of the marvels they want to know about is the telephone. For this reason, the Bell System now has major exhibits at the Museum of Science and Industry in Chicago and at the Franklin Institute in Philadelphia.

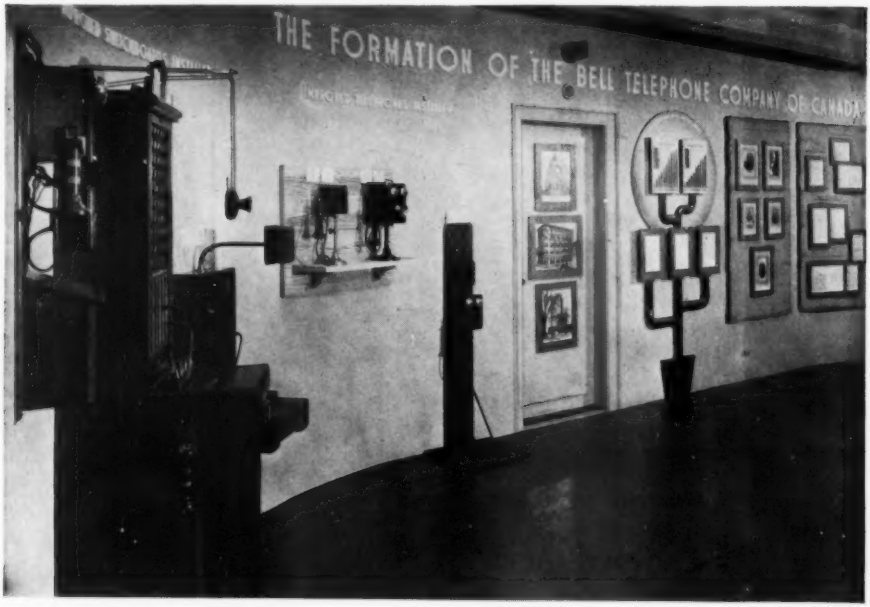
These visitors are learning about the operation of telephone relays in the Museum of Science and Industry in Chicago

The Chicago museum is one of the most beautiful and interesting buildings of its kind in the world. It uses every type of showmanship, but is unique in that most exhibits permit audience participation to a degree not approached elsewhere. During 1949, the museum attendance was 1,666,500, with the audience divided about evenly among men, women, and children. Surveys show that 80 percent of the visitors see the Illinois Bell Telephone Company's exhibit. Through the end of July, 1950, three months after installation, a voice mirror had been used 100,568 times, while a register on the overseas exhibit showed it had been operated 49,664 times.

The telephone theme unit at the Chicago museum tells dramatically the story of universal communications. A diorama represents a typical 500-mile section of country with numerous telephone central offices and mobile transmitters. By means of lights, buildings, and moving vehicles—a train, an auto, a ship, and an airplane—use of telephone communications to reach anyone anywhere can be shown. Visitors can operate the diorama by listening to a telephone receiver. While they see these calls traced out on the diorama, they hear a synchronized story.

Other museum exhibits at Chicago include transmission, how your telephone works, new Bell Laboratories developments, hearing tests, the one-millionth Chicago telephone, Western Electric manufacture, crossbar switches, and the ever-popular "Oscar demonstration" of binaural hearing. A small theater projects Bell System sound movies, and adjoining the theater is a children's workshop where youngsters may work with various items of telephone apparatus.

Another outstanding museum is the Franklin Institute in Philadelphia. Founded in 1824, and designed to be a permanent memorial



The "Panorama of Telephone Progress" in Montreal is representative of historical displays in several telephone company headquarters

to Benjamin Franklin, it is dedicated to the promotion of the mechanic arts and the dissemination of scientific knowledge.

About 300,000 people visited the Institute in 1950, and an estimated 200,000 a year will view the Bell Telephone Company of Pennsylvania's new exhibit there, which opened experimentally last April.

The elements of the main displays are similar to those in the Chicago Museum of Science and Industry. They tell a basic research story as applied to the field of telephony.

The layout consists of a circular room where the exhibits are set in recessed niches. It is on two floor levels, from which the various units may be viewed. Upon entering the room, visitors are directed by a sign to start the tour by ascending a stairway. They then proceed clockwise around a ramp to the bottom of another stairway. At this point they may enter either a hearing-test room or continue the tour of the exhibits located on the lower floor level.

The roster of exhibits covers such topics as speech and hearing, how the telephone works, transmission and switching, how dial switching works, overseas service, calls to mobile telephones, pathways for voice and vision, cross-country operator dialing, the hearing test room, transistors, growing crystals, manufacturing dial equipment, the new handset, and microwave radio relay.

The individual displays are designed for operation by the visitors, by means of push buttons or dials,

FACE-TO-FACE CONTACTS: BELL SYSTEM

Event	Attendance 1949	1950 Est.*
Fairs	2,900,000	4,150,000
Trade Expositions	2,100,000	2,200,000
"Open Houses," etc.	800,000	800,000
Traveling Exhibits ("Looking Ahead" and 1950 Exhibit)	76,000	97,000
Museums	1,500,000	2,000,000
Other Permanent Exhibits	—	1,000,000
Special Exhibits	—	1,500,000
Total	7,426,000	11,747,000

* Projection as of 12/15/50.

using the telephone instruments associated with the respective exhibits. Two exhibits are fully automatic and operate continuously for visitor observation. The radio relay exhibit is designed for demonstration by an attendant, who is assigned to the exhibit room at all times.

Museum telephone presentations are made clearly and comprehensively in three dimensions. Exhibits are designed to give ample opportunity for visitor participation. Utilizing light, color, motion, and various means of dramatic portrayal, such displays strive to make plain to everyone that the industrial application of science leads to the betterment of life on earth.

Several Bell System companies have historical exhibits in their headquarters building, and the Telephone Pioneers have often been the well-spring of contributions to such collections. Each year new ones are added, the latest being that of the Bell Telephone Company of Canada at Montreal. Called a "Panorama of Telephone Progress," it presents the development of the telephone by significant stages, starting with the telegraph and Bell's early models. It ends with examples of the latest achievements in telephony, some of which have not yet been put into actual plant operation.

THE BELL SYSTEM'S audio-visual information program is a teamwork undertaking. The Bell Laboratories, Western Electric, and Long Lines make significant contributions as new vistas of the art of telephony are revealed. All the Associated Companies take part, and many employees have a hand in it. The results, shown above in terms of customer attendance, are impressive.

Making possible those millions of face-to-face contacts is a constructive undertaking on a large scale, and the Bell System recognizes its opportunity—and its responsibility. For there must be a carefully balanced combination of interest and information if so many people are to gain through them a better understanding of the telephone and its operation, and perhaps, too, of telephone company problems and policies and objectives.

Foresight, Sturdy Plant, and Swift Restoration Minimize Effects of the Most Violent Storm Ever Experienced in The North-Eastern Section of the Country

Bell Companies in the East Withstand Heaviest Blow

Judson S. Bradley

THE GREAT and unexpected storm of November 25 was, the Weather Bureau reported, "the most violent of its kind ever recorded in the northeastern quarter of the United States." And to that statement many a weary telephone man and many a doubly busy telephone girl would have said a heartfelt *Amen.*

For the past dozen years, the New England hurricane of 1938 has been the measuring rod against which all eastern storms have been tried. In the viciousness with which wind and rain and fire and tide combined to assault telephone plant, and in the number of telephones put out of order, the New England hurricane has stood unequaled. But no longer. The Autumn storm of 1950, sweeping fiercely from West Virginia across Ohio and Pennsylvania, through New Jersey and New York and the six states of New England and on beyond, has in some respects outdone it. The tide along the Atlantic Coast was higher and in some places the snow was deeper than ever before, and in one day more telephones were knocked out of service than during the earlier catastrophe.

Wind was the arch villain. Its ferocity was brutal. Over vast areas it unroofed houses or blasted them from their foundations. Barns it blew apart, water towers and silos it toppled, commercial structures it damaged wherever and however it could.

Wind alone, when of the force of that gale, is a ruthless destroyer. Accompanying it were snow and sleet and rain. They were all manifestations of weather, and which one turned up depended pretty much on geography. But all three served, in one place and another, to increase the damage and complicate the tasks of reconstruction. Combined with wind, they sired a catastrophe. Its tragedy

The tide along the Atlantic coast was the highest . . .

is mourned in hundreds of deaths. Its damages are tallied in hundreds of millions of dollars.

Wind

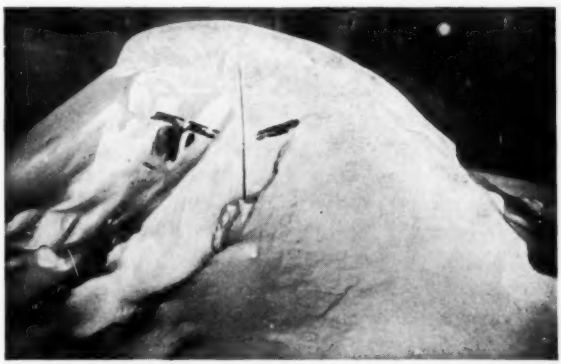
WIND topples trees.

Trees fall on wires and cables and break them off or bear them to the ground.

That, in brief, is the principal reason why more than 600,000 telephones were put out of service on November 25. Why calls could not go through on 3,200 toll and long distance circuits. Why 129 central offices were isolated from the rest of the Bell System wire network. Why the estimated cost of restoration will run to as much as $7,500,000.

That is the principal reason, but it isn't the only one. Not by a good deal! Snow is in the picture, too. In West Virginia and Ohio and Western Pennsylvania, more snow fell, and drifts were deeper, than ever before. Transportation of every kind collapsed. And people did what they usually do in such circumstances: they turned to the telephone, to transact their business, to give and to obtain reassurance, to take care of all the interests and necessities an emergency imposes.

Even though telephone plant in this part of the storm area suffered relatively little damage, telephone switchboards were soon attempting to handle peak loads of calls with too few operators. For blocked streets and highways stymied telephone people just as it did others. There are many tales of both men and girls whose courage and stamina overcame great obstacles to meet their obligations to the public by reporting for duty. Girls who had been taking late tricks the night before stayed on in rest rooms or nearby



. . . and in places the snow was the deepest on record

Sleet was an enemy in the suburbs . . .

hotels, to be on hand when needed. Supervisors and former operators took up cords. Girls who were off duty reported. Plant men got out heavy construction trucks and collected operators. At some times and in some places, telephone calls were answered only on an emergency basis. But all important ones were taken care of, and it was not long before all calls were being handled.

Western Pennsylvania was fortunate in escaping major damage to outside plant. But both sleet and floods harassed parts of the Central Area, and torrential rains accompanied the gale which staggered much of the Eastern Area. Yet despite its own troubles, the Bell Telephone Company of Pennsylvania was able to send five crews to the aid of its neighbor, the New Jersey Bell Telephone Company.

"Hot" Wires

New Jersey was, proportionately, hardest hit of all the Companies affected by the storm. By the time its fury had abated, Saturday evening, 2,000 cables were damaged or broken, and 135,000 telephones were dead.

Here, as wherever trees blew down, there was an important secondary cause of damage to wire and

. . . and in the open countryside as well

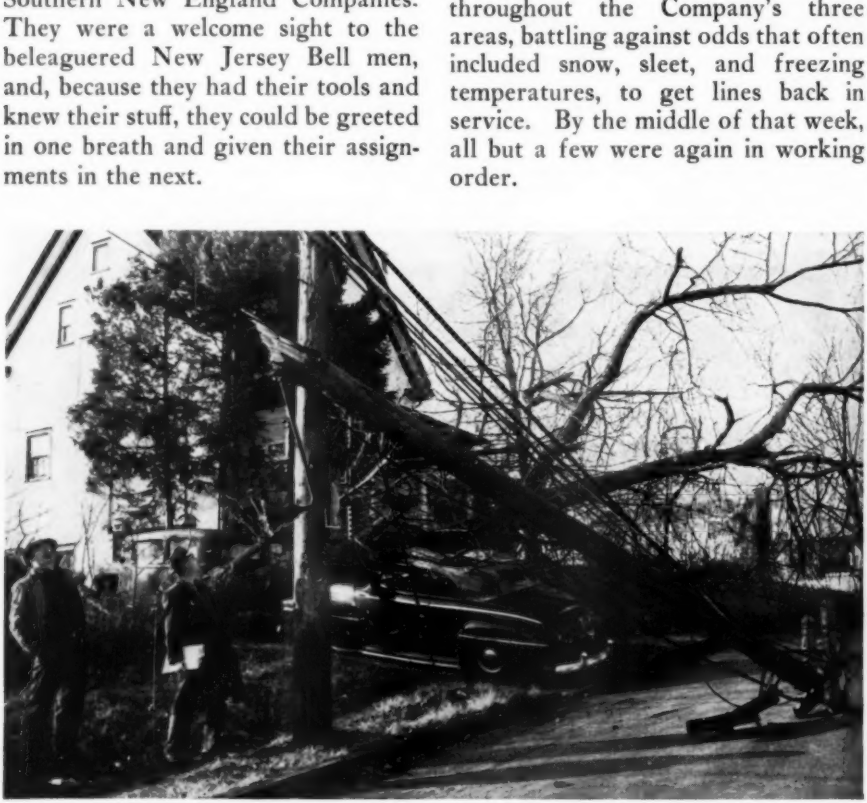
cable and of the failure of telephone service. Like the telephone companies, the light and power companies in the region suffered extensive damage to their wires. Their wires were "hot," however, and when they fell across telephone lines, they were likely to inflict power burns on the telephone cables. Short circuits and arcs would melt the cable sheath, damage the wires, and admit moisture; and if the cables had withstood the gale so far, they then went out of service—pronto. Moreover, in many cases telephone men could not start the process of untangling and repairing their own plant until current had been cut off in the live power wires. Telephone and electric companies throughout the storm area recognized that they were both victims of the unpredictable forces of Nature, and coöperation among them was cordial.

In New Jersey, telephone forces 5,000 strong were on the job by daylight on Sunday morning—the day after the big blow—to tackle the biggest repair job they had ever encountered. Test Bureau forces met an avalanche of trouble reports head-on, while operators who had struggled through the storm to bear a hand faced switchboards ablaze with light —"permanent" signals caused by damaged cables.

Playing on the Bell System Team

WHAT membership in the Bell System means, to both telephone workers and telephone users, was made evident once again when, promptly on Monday morning, trucks with men and their equipment began rolling in to New Jersey from other Bell companies which had been less hard hit and could spare them: the Chesapeake and Potomac, the Ohio Bell, the Bell of Pennsylvania, and, later in the week, the New York and the Southern New England Companies. They were a welcome sight to the beleaguered New Jersey Bell men, and, because they had their tools and knew their stuff, they could be greeted in one breath and given their assignments in the next.

The storm which raised such havoc in New Jersey kept right on going into New York State, throttle wide open and whistle blowing. Actually, the New York Telephone Company took the severest beating of all, on the basis of telephones out of service: 222,000. They were, however, spread out over an area from Long Island to the Canadian border. There had long been in existence here, as in all Bell Companies, an emergency plan to meet just such a disaster; and by Sunday morning, 9,500 men—the normal Sunday roster is less than 1,000—were at work throughout the Company's three areas, battling against odds that often included snow, sleet, and freezing temperatures, to get lines back in service. By the middle of that week, all but a few were again in working order.



More than telephone plant was damaged here

That Sunday was a day that operators will not soon forget, for the traffic averaged probably 70 percent above normal. On the following day an all-time record was set in New York City with a total of 20,087,000 calls.

Trouble in New England

In Connecticut, which is served by the Southern New England Telephone Company, more than 80,000 telephones were victims of that Saturday's storm, mostly along the Coast and in the central part of the state. As service was brought back to normal in the upper part of the state, men were transferred to the shore areas, and by the following Wednesday night, a convoy of 30 trucks, with their crews, was off for New Jersey.

One of the most unusual incidents of the whole storm period was the conversion of a telephone central office from manual to dial operation, exactly as scheduled, at 7 A.M. on Sunday, November 26—the day after the gale. The event, in Wallingford, Connecticut, had long been planned, and 5,000 customers had been notified; so, while more than 1,000 telephones were out of order in the Wallingford exchange, they would be neither more nor less out of order in a dial office than in a manual office, and the event took place successfully even as repairs were being carried on throughout the town.

East and north of Connecticut lie the other five states comprising New England, the territory of the New England Telephone and Telegraph Company. It is the most easterly

A splicing team works on cable down in the snow

The Other Side of the Picture

Damage is spectacular. Broken poles and tangled wires beside the road bespeak the fury of the storm.

Restoration is encouraging. Truck convoys rolling to the scene, skilled crews working valiantly to restore service, are a reassuring sight.

Such things attract attention. They make news.

But there is another side to the picture: the telephone plant which withstands the storm's assaults, the service which does not falter. Even in an emergency, they are pretty much taken for granted. And they are by far the larger part.

Let's look at this in terms of just one hard-hit Area of one telephone company, by way of making the point.

The storm put 39,000 telephones out of order there. But those telephones were 5.7 percent of all the telephones in that Area; and, because some people had extension telephones, actually only 5.25 percent of all customers were affected. Now, that is still a lot of people without service, and it is scant consolation to a man with a useless telephone to know that he is part of a small statistic. But the fact is that close to 95 out of every hundred telephones stayed in service; that for every customer who could not make a call, there were nearly 20 who could.

Incidentally, of those 39,000 telephones, better than 95 per cent—37,050—were repaired within twenty-four hours.

About 400 poles in that Area went down. But statistically they were twenty-four one-hundredths of one percent of all the telephone poles in service there. In other words, about 159,500 poles stood firm against the most violent storm of its kind ever experienced in that part of the country.

Or take, on the broader stage of the whole storm-stricken territory, the 475 telephone buildings which continued to furnish service despite the failure of their commercial power supply. Had not arrangements been made to overcome just such a situation if ever it should arise, who knows how many times greater might have been the number of telephones out of order, how many communities might have been entirely deprived of service?

Interruption to telephone service on such a scale is a serious matter. It must not be—and is not—taken lightly. But this account would be incomplete if it did not point out the brighter side of the picture.

section of the United States, and as the storm traversed it on its way out of the country, it did still further damage to the region's telephone service. When it had passed, 125,000 telephones were silent.

In Vermont, worst damaged of the New England states, the storm exhibited the characteristics of a tornado, using hit-run tactics as it struck cruelly at one point and passed another by unscathed. Twenty percent of the New England Telephone Company's telephones in that state were out. But 5,000 of the Company's men met the storm's bleak challenge with a dawn-to-dark restoration schedule, and by the middle of the following week such progress had been made in the other states which the Company serves that 360 men could be sent to the aid of their fellow workers in the Green Mountain State. Vermont took longer than the other New England states to straighten out, but the damage there too was licked by organization, materials, and skilled and loyal workers.

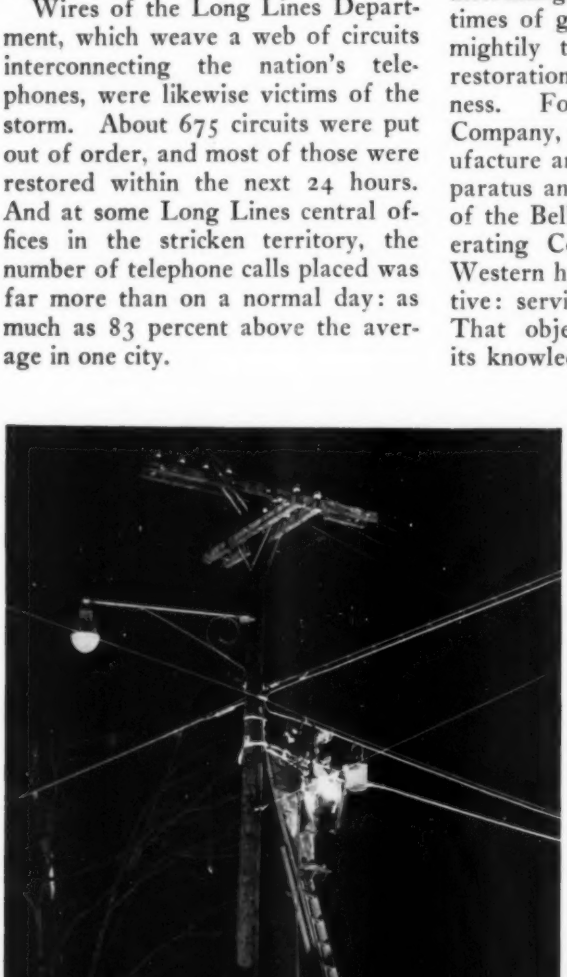
Thousands of feet of aerial cable had to be replaced

Mobile telephone service was important in maintaining emergency contacts

SINCE we noted earlier that 600,000 telephones were put out of service in one day—Saturday, November 25—it is appropriate to observe that more than half that number were restored within the next two days, and that by

the end of the week all were again in working order, as the result of extraordinary, persistent, and well-organized efforts—except for scattered cases in New Jersey and Vermont.

Wires of the Long Lines Department, which weave a web of circuits interconnecting the nation's telephones, were likewise victims of the storm. About 675 circuits were put out of order, and most of those were restored within the next 24 hours. And at some Long Lines central offices in the stricken territory, the number of telephone calls placed was far more than on a normal day: as much as 83 percent above the average in one city.



Night work carried on by flood light speeded the restoration of service

Western Electric Plays on the Same Team

THE SAME FORM of Bell System organization which makes possible the interchange of employees during times of great need also contributes mightily to another factor in the restoration of telephones to usefulness. For the Western Electric Company, whose business is the manufacture and supply of telephone apparatus and equipment, is a member of the Bell family, and, like the Operating Companies of the System, Western has only one ultimate objective: service to the telephone user. That objective it reaches through its knowledge of telephone company needs, through its great manufacturing capacity, and—additionally—through the spirit of service of its employees, which matches that of their colleagues in the Operating Companies.

When reports of damage hurtled into the Western Electric's distributing houses in the affected area, early on the morning of the storm, the first move was to line up warehousemen in preparation for rush calls for replacement equipment. As high winds continued and more and more trees went down, the rush calls came—and the big demand was for drop wire and associated line equipment. By that night, all drop wire had been shipped

not only from the distributing houses but from Western's Point Breeze Works in Baltimore as well. Point Breeze started Sunday noon to make drop wire on a round-the-clock schedule, and some of it had scarcely cooled by the time it was being used to restore service in New Jersey on Monday. Within that week, Western Electric shipped 18,000,000 linear feet of drop wire. That is a big figure; but it is no less typical of Western Electric's response to the need than is its Pittsburgh House's ability to get 500 telephone sets through blizzard-blocked lines to Harrisburg in the mail car of a passenger train, or its Supplies Service organization's skill in routing five cars of poles from the south around flood areas to fast delivery on Long Island, where there was urgent need for them. Shipment of key items by air was a usual procedure. Dozens of similar instances of the dovetailing of problem and solution could be cited, such is the quick-working relationship of the Operating Telephone Companies and Western Electric in the Bell System scheme of things.

WHILE 129 central offices were isolated for brief periods, a total of 475 telephone buildings would have been in a far more serious situation—unable to give service at all—if it had not been for emergency preparations made long since. For the commercial electric power which served those 475 buildings and normally kept the lines operating and the bells ringing, succumbed to the devastating force of the storm.

Such a situation had been foreseen, however. In 190 of the larger buildings, gasoline or diesel engine generators are part of the regular stand-by equipment. Portable engines were readily available to about 200 others. And in the remaining buildings, battery reserves had been designed to be adequate to the emergency demands made upon them.

A "power burn" may be seen in the cable just ahead of the splicer's right hand

Crews borrowed from other Bell companies came to the help of their New Jersey colleagues both aboard their own vehicles and by train

The new radio relay systems also gave striking evidence of their reliability. Between Boston and Chicago, six stations were among those without commercial power, but automatic emergency generators took up the load and there was no failure of service.*

Mobile radio telephone units again proved their value. One was dispatched to break the isolation of a small New Jersey community, for instance, but surrounding hills were found to be blanketing its signals. The engineers then drove it to the top of the highest hill, set up shop at one end of an open-wire span, and provided emergency service until a cable was repaired late that afternoon. Elsewhere, other radio units were rushed to several hospitals, where they relayed summonses for doctors and nurses and blood donors.

* See page 225.

And in Vermont, where difficulties were of the severest, several mobile radio units were used to furnish service until wire circuits could be reestablished, while the augmented repair forces in the state also used some units for supervisory and dispatching purposes.

The Three Ms

IMPLICIT in every page of this 20th-century saga is not only the skill but the loyalty and devotion of the men and women who furnish our telephone service day in and day out and who rise selflessly to the needs which some extraordinary situation imposes upon them.

There are three Ms which have a peculiar significance in such gigantic tasks as this.

Men—meaning the men and women of the Bell System—is the first M. Another M is for Materials, which are supplied quickly and in the necessary quantities by the Western Electric Company. The third M stands for Money. It takes but an instant's reflection to realize that only a financially strong and healthy system could face up to an emergency of such dimensions.

That particular emergency is over. The calls flow smoothly again. So it is not inappropriate to close this narrative with a jest—a jest which, often repeated in the harried days after the storm, still has its point. Somebody asked a Western Electric employee at one of the distributing houses, as things quieted down, what the supply job had been like. "It had us jumpin' for a while," he answered, "but all in all it was a pretty normal emergency."

In that jest lies a world of truth.

Western Electric merchandising supervisors give the go-ahead to a load of telephone plant items headed for the storm area

The A. T. & T. Company's Annual "Telephone Statistics Of the World" Summarizes Much Information about the Telephones in Service on All Continents

Where the World's Telephones Are

Elizabeth Wrenshall

THERE WERE approximately 70,300,000 telephones in service in the world on January 1, 1950.

We in this country have available to us, on the average, one telephone for every four persons; the world outside the United States has one for every 74 persons.

Pertinent data about the distribution of telephones by countries are published in *Telephone Statistics of the World,* the most recent issue of which has just been released. This survey is compiled annually by the Chief Statistician's Division of the American Telephone and Telegraph Company. Its statistics, supplied by some 300 government administrations or telephone operating companies throughout the world, present the only authoritative picture of total global telephone distribution.

Although the ultimate goal of being able to talk with any person at any time, wherever he may be, and at a reasonable cost, is still somewhat short of attainment, astonishing progress has been made toward its realization. The "electrical toy" which, three-quarters of a century ago, was judged to be interesting but of no practical value, is now regarded throughout the civilized world as being a commonplace necessity. Today, approximately 96 percent of the world's 70,300,000 telephones may potentially be connected with those of the Bell System, thereby bringing closer to us even the most remote of the habitable parts of the earth.

Not only are our places of business and residence interconnected, but we may speak from speeding vessels, motor cars, and trains.

Emerson could not foresee our efficient present-day system of communication, but he described it well:

"We had letters to send. Couriers could not go fast enough, nor

TELEPHONES IN CONTINENTAL AREAS
January 1, 1950 [a]

Continental Area	Total Telephones			Privately Owned		Automatic (Dial)		Connecting with Bell System	
	Number	Per Cent of Total World	Per 100 Population	Number	Per Cent of Total Tels.	Number	Per Cent of Total Tels.	Number	Per Cent of Total Tels.
North America	43,424,100	61.8	26.5	43,078,900	99.2	29,114,100	67.0	43,406,200	100 [b]
Middle America	523,900	0.7	1.0	485,300	92.6	349,200	66.7	508,300	97.0
South America	1,657,000	2.4	1.5	845,500	51.0	1,214,700	73.3	1,535,100	92.6
AMERICAS	45,605,000	64.9	14.1	44,409,700	97.4	30,678,000	67.3	45,449,600	99.7
EUROPE	20,000,000	28.4	3.3	2,896,700	14.5	12,900,000	64.5	17,960,000	89.8
AFRICA	805,600	1.1	0.4	12,400	1.5	525,400	65.2	668,400	83.0
ASIA	2,367,000	3.4	0.2	176,200	7.4	978,000	41.3	1,564,000	66.1
OCEANIA	1,522,400	2.2	11.3	100,000	6.6	948,600	62.3	1,508,000	99.1
WORLD	70,300,000	100.0	3.0	47,595,000	67.7	46,030,000	65.5	67,150,000	95.5

[a] Partly estimated; data reported as of other dates have been adjusted to January 1, 1950.
[b] Less than 0.05 per cent do not connect.

far enough; broke their wagons, foundered their horses; bad roads in Spring, snowdrifts in Winter, heat in Summer—could not get their horses out of a walk. But we found that the air and the earth were full of electricity, and always going our way, just the way we wanted to send. *Would he take a message?* Just as lief as not; had nothing else to do; would take it in no time."

Telephones Considered by Continental Areas

AS MAY BE SEEN in an accompanying table, 61.8 percent of the total number of telephones in the world are located on the continent of North America. Ninety-four percent of North America's telephones are in the United States. The ratio of telephones to population obtaining on this continent, 26.5 telephones per 100 inhabitants, is eight times that for Europe, which continent ranks second in telephone density. The city of New York alone has more telephones than have South and Middle America combined.

MIDDLE AMERICA

About one percent of the Western Hemisphere's telephones are located in Middle America. Bermuda has the highest telephone development within this grouping, with 15.6 telephones per 100 population. Mexico ranks first in respect to number of telephones in service, with 273,555. More than half of Mexico's telephones are located in its capital city.

SOUTH AMERICA

Argentina leads in number of telephones in South America, with 717,000. Of that number, 72 percent are in the city of Buenos Aires. Brazil, where telephony was introduced as early as 1881, ranks second in respect to absolute numbers, with 38 percent of its total in Rio de Janeiro. Chile occupies third place; approximately 55 per cent of that

country's telephones are grouped in its capital city, Santiago.

EUROPE

In considering total telephones by continents, Europe ranks second in respect to both absolute number and telephone density. The United Kingdom has more than twice as many telephones as has any other European country, but ranks fifth in telephone density among the large countries of Europe. Nearly 30 percent of the United Kingdom's telephones serve Greater London.

In point of absolute size, Germany's telephone system is Europe's second-largest. France's system ranks third, with 26 percent of its telephones in Paris. Sweden's is fourth in size (22 percent in Stockholm). The telephone system in the U.S.S.R. ranks fifth, that of Italy sixth (19 percent in Rome).

Considering the number of telephones in proportion to population in Europe's telephonically important countries, the first five are, respectively, Sweden (22.8), Switzerland (18.2), Denmark (15.8), Norway (13.3), and United Kingdom (10.2).

Europe and the Americas, in the aggregate, have 93 percent of the world's telephones.

AFRICA

805,600 telephones were reported to be in service in the continent of Africa, nearly 52 percent of them being in its southern-most country, the Union of South Africa. The regions on the north coast, i.e., Algeria, Egypt, Morocco and Tunisia, account for 35 percent of the total. This leaves only 104,728 telephones, or about the same number as in Richmond, Va., to serve all the rest of Africa's large territory.

ASIA

Asia, with its vast expanse of land and its enormous population (more than half of the world's inhabitants), has approximately the same number of telephones as those in service in the two cities of Chicago and Detroit combined; and of that number, 71 percent are in Japan. There is but one telephone, on the average, available to every 2600 people in India, one to every 1840 in China. In Asia, the concentration of telephones in principal cities is high: 44 percent of India's are in the two cities of Bombay and Calcutta, 16 percent of Japan's in Tokyo, 37 percent of China's in Shanghai. In Thailand, 100 percent of the telephones are located in the city of Bangkok.

Israel leads Asia's countries in regard to telephone density with 2.1 telephones per 100 population, followed by Japan with 2.0.

OCEANIA

Australia has 1,066,385 telephones, which is 70 percent of the total number in service in Oceania. Nearly half of Australia's telephones are located in the two cities of Melbourne and Sydney.

The telephone system of New Zealand is second in size among Oceania's countries. Telephone distribution in New Zealand is relatively even. Approximately 40 percent of the total are in the four largest cities. These cities in the aggregate have a telephone development of 18.7. The balance of the

Through overseas radio telephone transmitting stations such as this one at Lawrenceville, N. J., calls can reach 85 foreign countries or areas

country has a development of 18 telephones per 100 of the population.

Telephones in Large Countries

As of January 1, 1950, there were ten countries in the world which had more than one million telephones each. These, in order according to the number of telephones in their systems, were: the United States, the United Kingdom, Canada, Germany, France, Japan, Sweden, U.S.S.R., Italy, and Australia.

THE UNITED STATES

On January 1, 1950, there were 40,709,398 telephones—about 58 percent of all those in the world—in service in the United States, operated entirely under private ownership. The use of the telephone in this country has kept pace with the growth in population. In the decade from 1940 to 1950, notably, the absolute increase in the number of telephones and that in our population both approximated 19 million. We had 13.5 million more telephones at the beginning of 1950 than we had on VJ day. During the year 1949 alone we added more than 2.5 million telephones, or more than were in service in all of France at the end of that year.

Not only are more telephones being used, but they are being used more often: 355.1 telephone calls per capita were made in this country in 1949, as compared with 254.6 for the year 1944. The calls are lasting for a longer time, too. The average duration of a toll call, as reported

by the Long Lines Department of American Telephone and Telegraph Company, has increased by approximately half a minute during the past five-year period.

THE UNITED KINGDOM

The world's second-largest telephone system, that of the United Kingdom, reported 5,177,370 telephones as of March 31, 1950. This number represents 5,122,369 telephones operated by the British Post Office, and 55,001 operated by the telephone departments of the city of Hull and of the islands of Guernsey and Jersey. In respect to telephone density, the United Kingdom ranks ninth among the large countries of the world. The British telephone system, instituted under private ownership in 1878, was subsequently purchased by the government and is operated by the General Post Office. The United Kingdom is served by the world's largest government-owned telephone system.

CANADA

Canada's telephone system occupies third place in respect to both absolute numbers and telephones per 100 of the population. More than four-fifths of the total number of telephones in service are operated under private ownership. Canada's two largest cities, Montreal and Toronto, together contain 27 percent of the Dominion's telephones.

GERMANY

Germany ranks fourth in point of absolute number of telephones in service. Approximately 88 percent of the total are in Western Germany, which has a development of 4.4 telephones per 100 population. The telephone development of Eastern Germany plus Berlin is 1.4. Before World War II, Germany's telephone system was the largest outside the United States. It is entirely government-owned.

FRANCE

Telephone service was initiated in France in 1879 under private ownership. The government purchased the system in 1889, and has continued to operate it since that time under the Ministry of Posts, Telegraphs, and Telephones. As compared with the other telephone systems of the world, that of France ranks fifth in number of telephones in service. It ranks thirteenth in respect to telephone density, when compared in this respect with the world's large countries.

JAPAN

Japan, with 2.0 telephones per 100 of the population, has the sixth largest system in the world, wholly government-owned.

SWEDEN

Sweden, with 1,593,522 telephones in service, is second only to the United States in respect to telephone density (22.8 telephones per 100 of the population). In Sweden, as in so many other countries, telephony was introduced through private initiative. The government, which later acquired the private systems, today operates all but 0.1 percent of Sweden's telephones. The city of Stockholm has 22 percent of the total number in service. This city, with 46.9 telephones per 100 of its population, occupies third place

among large cities of the world in respect to telephone development.

U.S.S.R.

The telephone system in the U.S.S.R. ranks eighth in size. The estimated 1,500,000 total of telephones in service results in a telephone development of 0.7.

ITALY

The telephone service in Italy is operated by five concessionary companies, one in each of the five zones into which the country has been divided for this purpose. Each company operates local and toll service within its zone. The government operates interconnecting long distance service throughout the country. Italy ranks ninth among the countries of the world in respect to absolute number of telephones, with 1,118,685. More than one-third of Italy's telephones are located in its two largest cities, Rome and Milan.

AUSTRALIA

The Commonwealth of Australia, which embraces almost as much land area as does continental United States, reported 1,066,385 telephones as of January 1, 1950. Australia's telephone development is relatively high (13.2 telephones per 100 population), although it ranks third in this respect among Oceania's countries.

Cities

NEW YORK cannot boast of having as many telephones per 100 of its population as have some other metropolitan areas, but in absolute number of telephones it firmly maintains leadership, with 2,956,832. Only one *country*, other than the United States, has more telephones than are in service in the city of New York. In 1879, a single card bearing 252 names comprised the New York telephone directory. In July, 1949, one million copies of the Manhattan directory were printed, listing 672,100 names on 1,644 pages.

Greater London ranks second among the world's cities in point of number of telephones in service with 1,526,548; Chicago ranks third (1,495,900); Detroit fourth (828,795); Los Angeles fifth (827,582).

Telephone density in large cities is at its greatest in Washington, D. C., with 58.8 per 100 inhabitants. San Francisco, which for some years led the other cities of the world in this respect, is second with 54.5, and Stockholm is third with 46.9.

More than 25 large cities in the United States have a telephone density greater than 40 per 100 of the population.

People in rural areas have learned to appreciate and to demand good telephone service. Since the war, there has been an increase in farm telephones of approximately 50 percent in the United States. In most countries, a large proportion of the telephones are concentrated within their metropolitan areas, whereas only some seven per cent of this country's telephones serve the city of New York, for example. Localities in the United States having less than 50,000 population in the aggregate are served by more than three and one-half times the number of telephones in all of the Western Hemisphere outside the United States. More than two-fifths of our telephones serve places with less than 50,000 population.

(Statistical tables on pages 258–267)

TELEPHONES IN COUNTRIES OF THE WORLD

January 1, 1950

Country	Total Telephones		Ownership		Automatic (Dial)		Connecting with Bell System	
	Number	Per 100 Population	Government	Private	Number	Per Cent of Total Tels.	Number	Per Cent of Total Tels.
NORTH AMERICA:								
Alaska	14,618	11.2	67	14,551	4,150	28.4	14,618	100
Canada (1)	2,700,000*	19.6	345,000*	2,355,000*	1,530,800*	56.7	2,692,000*	99.7
Greenland	0	—	—	—	—	—	—	—
St. Pierre and Miquelon	100	2.0	100	—	0	—	0	—
United States	40,709,398	27.1	—	40,709,398	27,579,158	67.7	40,699,620	100(2)
MIDDLE AMERICA:								
Bahamas	3,400	4.5	3,400	—	3,400	100	3,400	100
Barbados	3,900	2.0	—	3,900	3,698	94.8	3,900	100
Bermuda (3)	5,600	15.6	—	5,600	5,600	100	5,600	100
British Honduras	655	1.0	655	—	0	—	0	—
Canal Zone (4)	6,141	7.7	6,141	—	6,141	100	6,141	100
Costa Rica	8,000*	0.9	200*	7,800*	0	—	0	—
Cuba	113,718	2.1	518	113,200	95,027	83.6	113,718	100
Dominican Republic	5,946	0.3	146	5,800	4,167	70.1	5,946	100
El Salvador	6,500*	0.3	2,200*	4,300*	0	—	6,500*	100
Guadeloupe	772	0.3	772	—	0	—	0	—
Guatemala	3,925	0.1	3,925	—	3,575	91.1	3,925	100
Haiti	3,809	0.1	3,809	—	3,355	88.1	2,419	63.5
Honduras	2,747	0.2	2,747	—	1,354	49.3	2,747	100
Jamaica	12,248	0.9	—	12,248	11,720	95.7	12,248	100
Leeward Islands	850	0.8	850	—	0	—	850	100
Martinique	1,666	0.6	1,666	—	0	—	0	—
Mexico	273,555	1.1	920	272,635	181,096	66.2	273,555	100
Netherlands' Antilles	2,600*	1.9	2,600*	—	2,200*	84.6	2,000*	76.9
Nicaragua	2,609	0.2	2,609	—	0	—	2,609	100
Panama	11,800	1.5	—	11,800	0	—	11,800	100
Puerto Rico	37,210	1.7	2,460	34,750	19,473	52.3	37,210	100
Trinidad and Tobago	13,546	2.1	—	13,546	8,931	65.9	13,546	100
Virgin Islands	1,000*	3.7	1,000*	—	0	—	1	0.1
Windward Islands	1,961	0.7	1,961	—	0	—	500	25.5
SOUTH AMERICA:								

Trinidad and Tobago	13,546	2.1	—	13,546	8,931	65.9	13,546	100
Virgin Islands	1,000*	3.7	1,000*	—	0	—	1	0.1
Windward Islands	1,961	0.7	1,961	—	0	—	500	25.5
SOUTH AMERICA:								
Argentina	717,000	4.4	647,302	69,698	535,000*	74.6	680,000*	94.8
Bolivia	7,900	0.2	—	7,900	7,450	94.3	7,000*	88.6
Brazil	517,000	1.0	1,500	515,500	390,000*	75.4	464,500*	89.8
British Guiana	3,160	0.8	3,160	—	175	5.5	3,160	100
Chile	131,344	2.3	—	131,344	87,607	66.7	131,344	100
Colombia	76,729	0.7	61,652	15,077	36,000*	46.9	60,000*	78.2
Ecuador	8,791	0.2	7,591	1,200	1,000	11.4	1,000	11.4
Falkland Islands	240	8.6	240	—	0	—	0	—
French Guiana	170	0.6	170	—	0	—	0	—
Paraguay	5,200	0.4	5,200	—	4,500*	86.5	4,400*	84.6
Peru	44,400	0.5	—	44,400	36,025	81.1	38,800	87.4
Surinam	1,710	0.8	1,710	—	0	—	1,500	87.7
Uruguay	84,100	3.6	83,022	1,078	61,548	73.2	84,100	100
Venezuela	59,300	1.3	—	59,300	55,442	93.5	59,300	100
EUROPE:								
Albania	1,200	0.1	1,200	—	0	—	0	—
Andorra	50	1.0	50	—	0	—	0	—
Austria	371,780	5.3	371,780	—	287,243	77.3	0	—
Belgium	649,555	7.5	649,555	—	484,364	74.6	649,555	100
Bulgaria	57,000*	0.8	57,000*	—	24,000*	42.1	0	—
Czechoslovakia	380,000*	3.1	380,000*	—	225,000*	59.2	225,000*	59.2
Denmark	680,703	15.8	34,287	646,416	276,512	40.6	680,703	100
Finland	313,975	7.7	38,278	275,697	169,210	53.9	313,975	100
France	2,318,673	5.6	2,318,673	—	1,411,678	60.9	2,318,673	100
Germany, Eastern, and Berlin	300,000*	1.4	300,000*	—	200,000*	66.7	200,000*	66.7
Germany, Western	2,112,728	4.4	2,112,728	—	1,062,012	50.3	2,112,728	100
Gibraltar	1,296	5.9	1,296	—	1,176	90.7	1,296	100
Greece	75,947	1.0	—	75,947	72,000*	94.8	75,947	100
Hungary	115,000*	1.2	115,000*	—	85,000*	73.9	85,000*	73.9
Iceland	19,600	13.9	19,600	—	12,533	63.9	19,600	100
Ireland	73,431	2.5	73,431	—	46,279	63.0	73,431	100

* Partly estimated.
(1) Including Newfoundland.
(2) Less than 0.03 per cent do not connect.
† Less than 0.1.
(3) June 30, 1950.
(4) Excluding telephone systems of the U. S. Military Forces; June 30, 1949.

TELEPHONES IN COUNTRIES OF THE WORLD—Continued

Country	Total Telephones: Number	Total Telephones: Per 100 Population	Ownership: Government	Ownership: Private	Automatic (Dial): Number	Automatic (Dial): Per Cent of Total Tels.	Connecting with Bell System: Number	Connecting with Bell System: Per Cent of Total Tels.
EUROPE:—*Continued.*								
Italy	1,118,685	2.4	—	1,118,685	1,015,105	90.7	989,649	88.5
Liechtenstein	1,642	12.6	1,642	—	0	—	1,642	100
Luxemburg	21,971	7.6	21,971	—	15,779	71.8	21,971	100
Malta and Gozo (5)	6,452	2.1	6,452	—	0	—	5,414	83.9
Monaco	2,665	14.0	2,665	—	2,342	87.9	2,405	90.2
Netherlands	692,412	6.9	692,412	—	615,498	88.9	692,412	100
Norway (6)	430,881	13.3	357,647	73,234	249,122	57.8	430,881	100
Poland	225,000*	0.9	225,000*	—	150,000*	66.7	150,000*	66.7
Portugal	132,300	1.5	39,244	93,056	66,376	50.2	131,126	99.1
Romania	135,000*	0.8	135,000*	—	100,000*	74.1	80,000*	59.3
San Marino	100*	0.8	100*	—	0	—	0	—
Spain	606,066	2.2	17,481	588,585	454,400	75.0	606,066	100
Sweden	1,593,522	22.8	1,591,473	2,049	985,708	61.9	1,591,473	99.9
Switzerland	845,471	18.2	845,471	—	808,644	95.6	845,471	100
Trieste	25,000*	6.9	2,000*	23,000*	20,000*	80.0	20,000*	80.0
U.S.S.R. (7)	1,500,000*	0.7	1,500,000*	—	400,000*	26.7	500,000*	33.3
United Kingdom (5)	5,177,370	10.2	5,177,370	—	3,650,429	70.5	5,177,370	100
Yugoslavia	80,000*	0.5	80,000*	—	48,000*	60.0	20,000*	25.0
AFRICA:								
Algeria	90,601	1.0	90,601	—	64,088	70.7	73,000*	80.6
Anglo-Egyptian Sudan	6,000*	†	6,000*	—	3,200*	53.3	3,800*	63.3
Belgian Congo	4,537	†	4,537	—	2,531	55.8	1,200	26.4
British East Africa	16,517	†	16,517	—	11,640	70.5	12,785	77.4
British South Africa	24,200	0.3	24,200	—	17,200	71.1	22,700	93.8
British Southwest Africa	3,780	1.2	3,780	—	1,624	43.0	3,397	89.9
British West Africa	14,621	†	14,621	—	978	6.7	0	—
Comoro Archipelago	0	—	—	—	—	—	—	—
Egypt	106,000*	0.5	106,000*	—	70,000*	66.0	106,000*	100
Eritrea	2,400*	0.2	2,400*	—	1,000*	41.7	0	—
Ethiopia	1,800*	†	1,800*	—	1,500*	83.3	0	—
French Cameroon	800*	0.3	800*	—	0	—	0	—
French Equatorial Africa	1,000*	†	1,000*	—	0	—	0	—
French Somaliland	296	0.7	296	—	0	—	0	—

Ethiopia	1,800*	†	1,800*	—	1,500*	83.3	0	—
French Cameroon	800*	0.3	800*	—	0	—	0	—
French Equatorial Africa	1,000*	†	1,000*	—	0	—	0	—
French Somaliland	296	0.7	296	—	0	—	0	—
French Togo	450	†	450	—	0	—	0	—
French West Africa	11,528	†	11,528	—	3,500*	30.4	0	—
Libya	6,000*	0.6	6,000*	—	5,000*	83.3	0	—
Liberia	0	—	—	—	—	—	—	—
Madagascar	5,119	0.1	5,119	—	0	—	0	—
Mauritius	4,200*	0.9	4,200*	—	0	—	0	—
Morocco	58,022	0.5	45,821	12,201	40,326	69.5	53,140	91.6
Portuguese Africa	6,007	†	6,007	—	130	2.2	0	—
Reunion	2,000*	0.8	2,000*	—	0	—	0	—
St. Helena	87	1.7	87	—	0	—	0	—
Seychelles	67	0.2	67	—	0	—	0	—
Somalia	300*	†	300*	—	0	—	0	—
Somaliland Protectorate	138	†	138	—	0	—	0	—
Spanish Guinea	238	0.1	—	238	0	—	0	—
Spanish Sahara	0	—	—	—	—	—	—	—
Tunisia	23,422	0.7	23,422	—	13,665	58.3	23,422	100
Union of South Africa	415,518	3.4	415,518	—	288,976	69.5	369,000*	88.8
ASIA:								
Aden, Colony of	1,216	1.5	1,216	—	1,216	100	0	—
Afghanistan	4,000*	†	4,000*	—	250	6.3	0	—
Bahrain	500*	0.4	500*	—	0	—	100*	20.0
Brunei	60	0.1	60	—	0	—	0	—
Burma	5,000*	†	5,000*	—	1,000*	20.0	0	—
Ceylon	15,839	0.2	14,884	955	13,549	85.5	0	—
China	250,000*	†	156,000*	94,000*	175,000*	70.0	90,000*	36.0
Cyprus	4,626	1.0	—	4,626	0	—	0	—
French India	76	†	76	—	76	100	0	—
French Indo-China	5,993	†	5,993	—	2,190	36.5	0	—
Hong Kong (6)	24,729	1.2	—	24,729	24,729	100	24,729	100
India (8)	128,911	†	127,249	1,662	54,000*	41.9	110,235	85.5
Indonesia	35,750	†	35,750	—	769	2.2	10,770	30.1
Iran	21,435	0.2	3,126	18,309	8,625	40.2	9,126	42.6
Iraq	16,249	0.3	16,249	—	11,213	69.0	0	—
Israel	24,686	2.1	24,686	—	21,371	86.6	24,686	100

* Partly estimated.
(5) March 31, 1950.
(6) June 30, 1949.

† Less than 0.1.
(7) Including all Asiatic territory of the U.S.S.R.
(8) March 31, 1949.

TELEPHONES IN COUNTRIES OF THE WORLD—Continued

Country	Total Telephones: Number	Total Telephones: Per 100 Population	Ownership: Government	Ownership: Private	Automatic (Dial): Number	Automatic (Dial): Per Cent of Total Tels.	Connecting with Bell System: Number	Connecting with Bell System: Per Cent of Total Tels.
ASIA—Continued								
Japan (5)	1,681,279	2.0	1,681,279	—	563,334	33.5	1,300,000*	77.3
Jordan	3,829	0.3	3,829	—	1,693	44.2	0	—
Korea	75,000*	0.3	75,000*	—	25,000*	33.3	20,000*	26.7
Lebanon	13,300*	1.1	13,300*	—	0	—	0	—
Malaya	20,362	0.4	20,362	—	6,846	33.6	0	—
North Borneo	481	0.1	481	—	110	22.9	0	—
Pakistan	17,445	†	17,445	—	8,718	50.0	17,445	100
Philippine Republic	17,968	†	—	15,968	12,102	75.8	13,724	85.9
Portuguese Asia	1,577	0.2	1,577	—	1,400	88.8	0	—
Sarawak	713	0.1	713	—	0	—	0	—
Saudi Arabia	3,000*	†	3,000*	—	0	—	0	—
Singapore	15,736	1.6	—	15,736	15,736	100	0	—
Syria	9,198	0.3	9,198	—	2,500	27.2	0	—
Thailand	5,800*	†	5,800*	—	5,800*	100	0	—
Turkey	58,169	0.3	58,169	—	49,862	85.7	0	—
Other Places	100*	†	100*	—	0	—	0	—
OCEANIA:								
American Samoa	289	1.6	289	—	289	100	0	—
Australia	1,066,385	13.2	1,066,385	—	651,561	61.1	1,066,385	100
Fiji	2,448	0.9	2,448	—	0	—	0	—
French Oceania	2,014	2.0	2,014	—	0	—	0	—
Hawaii	100,062	19.1	—	100,062	93,427	93.4	100,062	100
New Zealand (5)	348,539	18.2	348,539	—	204,701	58.7	346,737	99.5
Pacific Islands (British)	400	0.2	400	—	0	—	0	—
Papua-New Guinea	1,520	0.1	1,520	—	0	—	1,074	70.7
Portuguese Timor	235	†	235	—	0	—	0	—
South Seas Mandate (U. S.)	5,500*	3.9	5,500*	—	2,800	50.9	0	—
Western New Guinea	500*	0.1	500*	—	0	—	0	—
Western Samoa	326	0.4	326	—	0	—	0	—

* Partly estimated.
(5) March 31, 1950.

† Less than 0.1.

TELEPHONE DEVELOPMENT OF LARGE CITIES
January 1, 1950

Data relate in general to exchange or zone areas of the cities served. Usually such areas are larger than the corporate areas.

Country and City (or Exchange Area)	Estimated Population (In Thousands)	Number of Telephones	Telephones per 100 Population
ALGERIA:			
Algiers	320	31,872	10.0
Bona	103	2,444	2.4
Constantine	120	3,785	3.2
Oran	256	12,229	4.8
ARGENTINA:			
Buenos Aires	4,300	519,070	12.1
AUSTRALIA:			
Adelaide	406	58,578	14.4
Brisbane	424	66,947	15.8
Hobart	81	12,492	15.4
Melbourne	1,290	228,544	17.7
Newcastle	134	12,303	9.2
Perth	290	38,421	13.2
Sydney	1,571	266,553	17.0
AUSTRIA:			
Graz	225	19,813	8.8
Vienna	1,550	201,214	13.0
BELGIUM:			
Antwerp	577	64,613	11.2
Brussels	933	211,886	22.7
Charleroi	275	26,615	9.7
Ghent	218	24,254	11.1
Liége	366	44,175	12.1
Verviers	77	14,532	18.9
BRAZIL:			
Belo Horizonte	300	11,165	3.7
Pôrto Alegre	321	17,772	5.5
Rio de Janeiro	2,325	198,711	8.5
Santos	230	12,904	5.6
São Paulo	1,840	106,649	5.8
CANADA:			
Calgary	120	36,742	30.6
Edmonton	140	33,465	23.9
Halifax	118	34,787	29.5
Hamilton	201	62,209	30.9
London	115	34,944	30.4
Montreal	1,318	361,728	27.4
Ottawa	267	81,859	30.7
Quebec	210	53,556	25.5
Toronto	915	371,764	40.6
Vancouver	426	129,096	30.3
Victoria	99	30,628	30.9
Windsor	152	40,434	26.7
Winnipeg	368	88,150	24.0
CHILE:			
Santiago	1,162	72,574	6.2
Valparaiso	183	9,567	5.2
CUBA:			
Havana	924	79,464	8.6
DENMARK:			
Aalborg	65	14,762	22.7
Aarhus	114	25,422	22.3
Copenhagen	972	314,351	32.3
Odense	99	19,201	19.4
FINLAND:			
Helsinki	388	86,236	22.2
Tampere	98	9,729	9.9
Turku	103	13,237	12.9
FRANCE:			
Bordeaux	255	34,358	13.5
Le Havre	130	12,306	9.5
Lille	211	22,697	10.8
Lyon	547	64,801	11.8
Marseille	640	58,889	9.2
Nantes	202	17,150	8.5
Nice	213	22,444	10.5
Paris	2,760	610,270	22.1
Roubaix	180	19,813	11.0
St. Etienne	180	13,846	7.7
Strasbourg	178	18,445	10.4
Toulouse	266	18,722	7.0
GERMANY:			
Berlin	3,308	100,377	3.0
Bremen	351	36,450	10.4
Cologne	593	48,687	8.2
Düsseldorf	495	49,054	9.9
Essen	600	24,014	4.0
Frankfort-on-Main	619	59,469	9.6
Hamburg-Altona	1,578	166,137	10.5
Hanover	486	33,425	6.9
Munich	857	69,246	8.1
Nuremberg	522	32,616	6.2
Stuttgart	627	43,328	6.9
Wiesbaden	218	15,717	7.2
HAWAII:			
Honolulu	238	71,186	29.9
ICELAND:			
Reykjavik	57	11,696	20.5
INDIA: (1)			
Bombay	3,700	29,473	0.8
Calcutta	5,900	27,824	0.5
INDONESIA:			
Bandoeng	692	4,104	0.6

(1) March 31, 1949.

† Less than 0.1.

* Partly estimated. (5) March 31, 1950.

TELEPHONE DEVELOPMENT OF LARGE CITIES—Continued

Country and City (or Exchange Area)	Estimated Population (In Thousands)	Number of Telephones	Telephones per 100 Population
IRAN:			
Teheran	750	9,126	1.2
IRAQ:			
Baghdad	567	10,003	1.8
IRELAND:			
Cork	76	4,118	5.4
Dublin	528	42,161	8.0
ISRAEL:			
Jerusalem	103	5,036	4.9
Tel Aviv and Jaffa	307	9,379	3.1
ITALY:			
Bari	226	6,036	2.7
Bologna	292	23,763	8.1
Catania	292	8,289	2.8
Florence	322	36,082	11.2
Genoa	377	56,325	14.9
Milan	1,274	213,281	16.7
Naples	950	34,348	3.6
Palermo	492	13,018	2.6
Rome	1,553	214,548	13.8
Turin	713	82,530	11.6
Venice	197	16,496	8.4
JAMAICA:			
Kingston	266	10,133	3.8
JAPAN: (2)			
Fukuoka	385	15,641	4.1
Hakodate	228	10,454	4.6
Hiroshima	258	8,513	3.3
Kanazawa	253	13,496	5.3
Kobe	777	25,795	3.3
Kyoto	1,095	59,306	5.4
Nagoya	1,004	39,773	4.0
Osaka	1,934	105,900	5.5
Otaru	178	9,758	5.5
Sapporo	289	13,786	4.8
Tokio	6,110	263,163	4.3
Yokohama	931	25,029	2.7
MEXICO:			
Guadalajara	300	12,289	4.1
Mexico, D. F.	2,107	143,173	6.8
Monterrey	262	13,881	5.3
Puebla	175	9,975	5.7
MOROCCO:			
Casablanca	550	10,158	1.8
Rapat	165	4,881	3.0
Tetuan	80	3,209	4.0
NETHERLANDS:			
Amsterdam	836	94,220	11.3
Arnhem	103	10,202	9.9
NETHERLANDS (continued):			
Eindhoven	141	9,165	6.5
Enschede	107	6,486	6.1
Groningen	148	15,337	10.4
Haarlem	206	20,926	10.2
The Hague	618	84,218	13.6
Leiden	105	10,466	10.0
Nijmegen	117	8,274	7.1
Rotterdam	749	68,862	9.2
Tilburg	120	7,069	5.9
Utrecht	212	20,992	9.9
NEW ZEALAND: (2)			
Auckland	300	47,717	15.9
Christchurch	171	26,685	15.6
Dunedin	88	18,101	20.6
Wellington	195	48,530	24.9
NORWAY: (3)			
Bergen	114	21,368	18.7
Oslo	428	110,769	25.9
Stavanger	51	9,570	18.8
Trondheim	58	12,451	21.5
PAKISTAN:			
Karachi	1,000	5,544	0.6
PERU:			
Lima	720	31,460	4.4
PHILLIPINE REPUBLIC:			
Manila	1,043	12,102	1.2
PORTUGAL:			
Lisbon	821	58,450	7.1
Oporto	335	20,574	6.1
PUERTO RICO:			
San Juan	223	17,013	7.6
SPAIN:			
Barcelona	1,285	91,796	7.1
Bilbao	234	20,753	8.9
Madrid	1,470	144,677	9.8
Seville	405	16,536	4.1
Valencia	540	22,718	4.2
Zaragoza	272	13,366	4.9
SWEDEN:			
Borås	57	15,282	26.8
Eskilstuna	53	11,855	22.4
Göteborg	349	114,994	32.9
Hälsingborg	71	18,035	25.4
Linköping	53	13,906	26.2
Malmö	189	54,113	28.6
Norrköping	84	21,073	25.1

(2) March 31, 1950.
(3) June 30, 1949.

TELEPHONE DEVELOPMENT OF LARGE CITIES—Continued

Country and City (or Exchange Area)	Estimated Population (In Thousands)	Number of Telephones	Telephones per 100 Population
SWEDEN (continued):			
Örebro	66	19,866	30.1
Stockholm	734	344,315	46.9
Uppsala	62	18,373	29.6
Västerås	58	14,753	25.4
SWITZERLAND:			
Basel	182	70,698	38.8
Bern	143	60,238	42.1
Geneva	148	54,092	36.5
Lausanne	106	35,001	33.0
Lucerne	60	21,786	36.3
St. Gallen	67	17,782	26.5
Winterthur	66	13,213	20.0
Zurich	385	133,016	34.5
TRIESTE:			
Trieste	275	21,053	7.7
TRINIDAD AND TOBAGO:			
Port of Spain	103	8,313	8.1
TUNISIA:			
Tunis	625	13,665	2.2
TURKEY:			
Ankara	230	12,372	5.4
Istanbul	870	26,420	3.0
UNION OF SOUTH AFRICA:			
Bloemfontein	91	6,359	7.0
Cape Town	524	56,395	10.8
Durban	417	40,480	9.7
East London	87	7,050	8.1
Germiston	152	5,137	3.4
Johannesburg	865	101,013	11.7
Kimberley	62	2,731	4.4
Pietermaritzburg	69	7,162	10.4
Port Elizabeth	164	14,013	8.5
Pretoria	287	29,734	10.4
UNITED KINGDOM:			
Belfast	452	33,600	7.4
Birmingham	1,321	112,070	8.5
Bradford	289	30,100	10.4
Bristol	437	50,495	11.6
Cardiff	251	22,617	9.0
Coventry	253	20,870	8.2
Edinburgh	488	72,828	14.9
Glasgow	1,208	116,211	9.6
Kingston upon Hull(2)	354	37,067	10.5
Leeds	588	61,597	10.5
Leicester	281	31,330	11.1
Liverpool	1,266	114,080	9.0
London, City and County of	3,376	844,207	25.0
London, Greater	8,391	1,526,548	18.2
Manchester	1,241	128,900	10.4
Newcastle-upon-Tyne	520	43,615	8.4
UNITED KINGDOM (continued):			
Nottingham	424	41,600	9.8
Portsmouth	216	15,136	7.0
Sheffield	512	42,900	8.4
Stoke-upon-Trent	278	14,593	5.2
URUGUAY:			
Montevideo	770	61,548	8.0
VENEZUELA:			
Caracas, D. F.	700	42,911	6.1
UNITED STATES:			
Akron, O.	388	136,018	35.1
Alameda, Cal.	(Included in Oakland)		
Albany, N. Y.	176	74,910	42.5
Albuquerque, N. M.	115	32,793	28.5
Alhambra, Cal.	153	45,596	29.8
Allentown, Pa.	124	42,973	34.7
Altoona, Pa.	90	28,692	31.8
Amarillo, Tex.	79	29,500	37.3
Anderson, Ind.	69	22,098	32.1
Asheville, N. C.	79	23,860	30.1
Atlanta, Ga.	565	193,248	34.2
Atlantic City, N. J.	75	40,094	53.4
Augusta, Ga.	133	29,345	22.1
Aurora, Ill.	63	23,509	37.3
Austin, Tex.	152	48,834	32.2
Baltimore, Md.	950	295,074	31.1
Baton Rouge, La.	162	43,329	26.7
Bay City, Mich.	73	22,890	31.4
Bayonne, N. J.	77	19,952	26.0
Beaumont, Tex.	108	32,732	30.4
Berkeley, Cal.	(Included in Oakland)		
Berwyn, Ill.	54	16,263	30.0
Bethlehem, Pa.	80	26,920	33.8
Binghamton, N. Y.	105	34,631	33.0
Birmingham, Ala.	443	121,493	27.4
Boston, Mass.	732	293,201	40.1
Bridgeport, Conn.	213	75,645	35.6
Brockton, Mass.	71	23,337	32.9
Brookline, Mass.	84	35,783	42.7
Buffalo, N. Y.	732	244,304	33.4
Burbank, Cal.	96	35,998	37.5
Cambridge, Mass.	124	45,606	36.7
Camden, N. J.	127	37,358	29.4
Canton, O.	150	52,046	34.6
Cedar Rapids, Ia.	77	30,101	39.3
Charleston, S. C.	124	28,193	22.7
Charleston, W. Va.	129	40,956	31.9
Charlotte, N. C.	173	53,841	31.1
Chattanooga, Tenn.	196	65,320	33.3
Chester, Pa.	103	30,155	29.4
Chicago, Ill.	3,630	1,495,900	41.2
Cicero, Ill.	67	23,614	35.1
Cincinnati, O.	685	233,817	34.1
Cleveland, O.	1,267	517,618	40.9
Cleveland, Heights, O.	(Included in Cleveland)		

TELEPHONE DEVELOPMENT OF LARGE CITIES—Continued

Country and City (or Exchange Area)	Estimated Population (In Thousands)	Number of Telephones	Telephones per 100 Population
UNITED STATES (continued):			
Clifton, N. J.	(Included in Passaic)		
Columbia, S. C.	156	35,176	22.5
Columbus, Ga.	146	29,916	20.5
Columbus, O.	453	173,354	38.3
Corpus Christi, Tex.	134	36,981	27.6
Covington, Ky.	160	43,116	26.9
Cranston, R. I.	(Included in Providence)		
Dallas, Tex.	525	214,756	40.9
Davenport, Ia.	87	32,344	37.2
Dayton, O.	344	125,725	36.5
Dearborn, Mich.	(Included in Detroit)		
Decatur, Ill.	87	28,519	32.9
Denver, Colo.	420	185,311	44.1
Des Moines, Ia.	210	82,719	39.4
Detroit, Mich.	2,230	828,795	37.2
Dubuque, Ia.	53	18,383	34.7
Duluth, Minn.	115	41,485	36.1
Durham, N. C.	92	22,430	24.3
East Chicago, Ind.	54	13,757	25.4
East Orange, N. J.	145	52,354	36.2
East St. Louis, Ill.	106	24,959	23.6
Elizabeth, N. J.	121	39,799	32.8
El Paso, Tex.	150	37,544	25.0
Erie, Pa.	153	45,804	29.9
Evanston, Ill.	72	34,482	47.8
Evansville, Ind.	155	49,932	32.2
Fall River, Mass.	131	34,062	26.0
Flint, Mich.	207	70,748	34.2
Fort Smith, Ark.	64	18,758	29.5
Fort Wayne, Ind.	140	59,135	42.2
Fort Worth, Tex.	348	115,220	33.1
Fresno, Cal.	145	52,516	36.2
Gadsden, Ala.	71	14,321	20.1
Galveston, Tex.	72	28,164	39.3
Gary, Ind.	140	38,826	27.8
Glendale, Cal.	92	37,876	41.2
Grand Rapids, Mich.	249	95,049	38.2
Green Bay, Wis.	70	21,947	31.4
Greensboro, N. C.	109	31,874	29.3
Greenville, S. C.	98	27,357	28.1
Hamilton, O.	75	22,143	29.6
Hammond, Ind.	81	22,388	27.5
Hamtramck, Mich.	(Included in Detroit)		
Harrisburg, Pa.	145	63,334	43.7
Hartford, Conn.	284	123,684	43.5
Highland Park, Mich.	(Included in Detroit)		
Hoboken, N. J.	(Included in Jersey City)		
Holyoke, Mass.	79	24,198	30.6
Houston, Tex.	688	255,066	37.1
Huntington, W. Va.	94	32,045	34.2
Indianapolis, Ind.	549	203,598	37.1
Irvington, N. J.	(Included in Newark)		
Jackson, Mich.	86	31,799	37.2
Jackson, Miss.	115	35,395	30.7
Jacksonville, Fla.	281	69,965	24.9
UNITED STATES (continued):			
Jersey City, N. J.	351	96,648	27.5
Johnstown, Pa.	109	24,867	22.8
Joliet, Ill.	96	26,183	27.4
Kalamazoo, Mich.	106	39,599	37.4
Kansas City, Kans.	(Included in Kansas City, Mo.)		
Kansas City, Mo.	639	263,489	41.2
Kenosha, Wis.	64	19,832	31.2
Knoxville, Tenn.	200	56,798	28.3
Lakewood, O.	(Included in Cleveland)		
Lancaster, Pa.	86	34,802	40.4
Lansing, Mich.	145	55,938	38.6
Laredo, Tex.	53	7,669	14.5
Lawrence, Mass.	114	30,124	26.4
Lexington, Ky.	94	24,092	25.5
Lima, O.	57	22,624	39.8
Lincoln, Neb.	104	40,997	39.6
Little Rock, Ark.	177	55,394	31.4
Long Beach, Cal.	269	108,207	40.2
Lorain, O.	57	16,350	28.7
Los Angeles, Cal.	1,900	827,582	43.6
Louisville, Ky.	438	146,242	33.4
Lowell, Mass.	122	30,755	25.2
Lubbock, Tex.	82	22,147	27.2
Lynn, Mass.	117	45,339	38.8
Macon, Ga.	114	28,643	25.1
Madison, Wis.	114	46,516	40.7
Malden, Mass.	61	18,162	29.9
Manchester, N. H.	88	24,922	28.4
McKeesport, Pa.	121	32,547	26.8
Medford, Mass.	61	16,695	27.3
Memphis, Tenn.	463	140,915	30.4
Miami, Fla.	473	175,370	37.1
Miami Beach, Fla.	(Included in Miami)		
Milwaukee, Wis.	839	293,320	35.0
Minneapolis, Minn.	648	267,221	41.2
Mobile, Ala.	197	45,977	23.4
Montgomery, Ala.	146	29,901	20.5
Mt Vernon, N. Y.	79	27,289	34.8
Muncie, Ind.	71	23,944	33.8
Nashville, Tenn.	267	94,801	35.5
Newark, N. J.	522	188,286	36.1
New Bedford, Mass.	136	40,008	29.4
New Britain, Conn.	83	26,528	31.8
New Castle, Pa.	71	21,695	30.7
New Haven, Conn.	252	100,860	40.0
New Orleans, La.	641	202,306	31.5
New Rochelle, N. Y.	65	23,973	36.8
Newton, Mass.	81	31,809	39.4
New York, N. Y.	8,000	2,956,832	37.0
Niagara Falls, N. Y.	93	31,379	33.6
Norfolk, Va.	245	72,104	29.4
Oakland, Cal.	643	275,524	42.8
Oak Park, Ill.	63	27,385	43.3
Ogden, Utah	88	25,768	29.4
Oklahoma City, Okla.	259	110,873	42.7
Omaha, Neb.	283	109,699	38.8

TELEPHONE DEVELOPMENT OF LARGE CITIES—Continued

Country and City (or Exchange Area)	Estimated Population (In Thousands)	Number of Telephones	Telephones per 100 Population
UNITED STATES (continued):			
Orlando, Fla.	71	22,306	31.4
Pasadena, Cal.	170	77,700	45.7
Passaic, N. J.	160	45,703	28.5
Paterson, N. J.	175	54,506	31.1
Pawtucket, R. I.	132	34,174	25.9
Peoria, Ill.	174	59,050	33.9
Philadelphia, Pa.	2,063	740,183	35.9
Phoenix, Ariz.	225	62,662	27.8
Pittsburgh, Pa.	1,036	388,060	37.5
Pittsfield, Mass.	55	21,400	38.9
Pontiac, Mich.	121	40,869	33.8
Port Arthur, Tex.	73	22,409	30.9
Portland, Me.	108	38,853	35.9
Portland, Ore.	475	191,880	40.4
Portsmouth, Va.	112	21,435	19.1
Providence, R. I.	367	121,655	33.1
Pueblo, Colo.	87	24,863	28.6
Quincy, Mass.	84	27,720	33.1
Racine, Wis.	86	28,922	33.8
Raleigh, N. C.	96	27,916	29.2
Reading, Pa.	147	52,783	36.0
Richmond, Cal.	128	23,424	18.3
Richmond, Va.	269	102,803	38.2
Roanoke, Va.	114	36,163	31.7
Rochester, N. Y.	419	138,959	33.2
Rockford, Ill.	137	46,975	34.3
Sacramento, Cal.	225	82,735	36.8
Saginaw, Mich.	123	39,398	32.2
St. Joseph, Mo.	86	30,135	35.0
St. Louis, Mo.	984	375,874	38.2
St. Paul, Minn.	374	144,221	38.6
St. Petersburg, Fla.	124	34,439	27.9
Salt Lake City, Utah	217	84,012	38.7
San Angelo, Tex.	56	12,393	22.2
San Antonio, Tex.	458	119,790	26.2
San Bernardino, Cal.	70	25,234	36.0
San Diego, Cal.	300	107,229	35.7
San Francisco, Cal.	788	429,678	54.5
San Jose, Cal.	160	52,395	32.7
Santa Monica, Cal.	148	54,466	36.8
Savannah, Ga.	151	36,516	24.2
Schenectady, N. Y.	145	57,587	39.8
Scranton, Pa.	146	44,458	30.4
UNITED STATES (continued):			
Seattle, Wash.	572	258,545	45.2
Shreveport, La.	181	53,545	29.7
Sioux City, Ia.	86	31,888	37.1
Sioux Falls, S. D.	56	20,555	36.4
Somerville, Mass.	99	24,654	24.9
South Bend, Ind.	193	60,693	31.5
South Gate, Cal.	(Included in Los Angeles)		
Spokane, Wash.	195	73,334	37.6
Springfield, Ill.	100	39,500	39.7
Springfield, Mass.	202	76,752	38.0
Springfield, Mo.	91	30,026	33.0
Springfield, O.	92	32,625	35.5
Stamford, Conn.	76	31,051	40.9
Stockton, Cal.	119	37,532	31.5
Syracuse, N. Y.	259	99,476	38.4
Tacoma, Wash.	189	66,341	35.1
Tampa, Fla.	186	52,908	28.5
Terre Haute, Ind.	100	25,820	25.9
Toledo, O.	355	134,601	37.9
Topeka, Kans.	103	37,017	36.1
Trenton, N. J.	195	57,909	29.7
Troy, N. Y.	85	24,894	29.4
Tucson, Ariz.	107	35,967	33.6
Tulsa, Okla.	203	92,481	45.6
Union City, N. J.	163	45,164	27.7
Utica, N. Y.	135	41,325	30.7
Waco, Tex.	95	27,797	29.2
Washington, D. C.	791	465,148	58.8
Waterbury, Conn.	113	40,896	36.2
Waterloo, Ia.	70	23,887	34.1
Wheeling, W. Va.	72	25,292	35.1
Wichita, Kans.	194	75,680	39.0
Wichita Falls, Tex.	74	24,321	32.9
Wilkes-Barre, Pa.	118	32,975	27.9
Wilmington, Del.	160	66,434	41.5
Winston-Salem, N. C.	119	32,839	27.5
Woonsocket, R. I.	71	19,206	27.2
Worcester, Mass.	212	73,019	34.4
Yonkers, N. Y.	151	44,653	29.6
York, Pa.	97	21,776	22.5
Youngstown, O.	225	71,973	31.9

Twenty-five Years Ago in the

BELL TELEPHONE QUARTERLY

Items from Volume V, Number 1, January 1926

The Semi-Centennial of the Telephone

OF ALL the agencies employed in the communications of the world, the telephone is the most wonderful. More than any other, the telephone art is a product of American institutions and reflects the genius of our people. The story of its development is a story of our own country, of American enterprise and American progress. With very few exceptions, the best that is used in telephony everywhere in the world to-day has been contributed by America.

During the year 1926 will be observed with appropriate ceremonies the semi-centennial of the invention of the telephone. Much will be said and written concerning the marvels which have been achieved during the past fifty years, in extending its use among all the people of our nation by means of a continental system of wires and by the most recent marvel of the radio. These things are largely dependent upon the fundamental discovery which was made by Alexander Graham Bell and upon the unremitting labors of the scientific men in those laboratories founded by him fifty years ago and which bear his name.

So much has been achieved during the last half century in the scientific and business development of the telephone in America, that we can look forward with a confidence born of experience to the astonishing things that will have been accomplished by the successors of Bell at the end of the next fifty years, when our country celebrates the second hundred years of its existence as a nation.

While it is impossible to predict in detail what will be the nature of these great new developments, we can be sure that the problems which we can now see ahead of us contain the promise of marvels greater than anything which we can now imagine.

As recently stated by Mr. W. S. Gifford, President of the American Telephone and Telegraph Company, "The advances which have been made during the first fifty years of the work of the Bell System are unparalleled in the history of communications. They are contributions which will make forever memorable this great epoch in our progress. We are now at the beginning of a new era filled with boundless opportunities for advancement in the business and science of telephony. Upon the foundations which have been so securely laid, we can look forward to the telephone system of the future which, in effectiveness and useful service, will surpass all that has gone before."

From an article by the late John J. Carty, then chief engineer of the A. T. & T. Co.

A New Record in Military Communications

AN EXPERIMENT in the transmission of photographs over telephone lines, carried out on October 2, 1925, through the co-operation of the United States War Department and the American Telephone and Telegraph Company, set a new record for the rapid communication of military intelligence.

A photograph of the barracks at Fort Leavenworth, Kan. (theoretically occupied by enemy troops), which had been taken from a military observing plane at 10.57 A.M., was placed in the hands of army of-

ficers in New York at 11.17½ A.M.—twenty-nine and a half minutes from the snapping of the shutter to the delivery of the finished picture at a point 1,100 miles away. Simultaneously pictures were flashed by the Bell System telephotographic process to the commanders of Army Corps areas in Chicago and San Francisco, the finished print being delivered at the latter point thirty-seven minutes after the photograph was taken.

The success of the experiment was due to a combination of the system of sending pictures by wire with a new process of developing photographs in an airplane, perfected by army photographers. After making the exposure, the military photographer immediately began developing the film and when, nine minutes later, the plane flew over the nearest telephone office, the negative, attached to a small parachute, was dropped overboard.

At 11.05½ the photograph was put on the wire. Twelve minutes later the completed picture was received in New York and at 11.22 A.M. officials at Fort Leavenworth had received a telegram from their associates in New York, reporting the satisfactory reception of the print and declaring the skill of the Air Service and of the American Telephone and Telegraph Company to be "worthy of the highest praise."

From "Notes on Recent Occurrences"

Sound Your "Ah"

THE ST. LOUIS *Star-Times* reports an incident which transpired recently in McAllen, Texas. As the newspaper tells it, "A woman got on the wahr and tried to telephone the nearby town of Pharr. The hahred hand on the switchboard thought she was reporting a fahr. So, without stopping to inquahr, she sounded the fahr alarm and aroused the entahr community. Most of the volunteer fahr fighters had already retahred. They began to perspahr and struggle into their fahrfighting attahr. It was the nicest little mixup you could desahr." Inspahred by the entahr affair, the *Star-Times* warns its readers that, "Some people are used to damyankee accents," and suggests that they acquahr the habit of speaking plainly on the telephone. "When you mean Pharr, say Pharr," it advises, "and when you mean fahr, say fahr."

Who's Who & What's What

(*Continued from page 195*)

1925, after several years of editorial and publishing experience, he transferred five years later to the corresponding department of the A. T. & T. Company, where he has been for the past eight years editor of this MAGAZINE. (Both pictures on p. 241 from International News Photos.)

MUCH of the information—annual reports, correspondence, publications, and the like—received from foreign telephone administrations in connection with the A. T. & T. Company's bulletin "Telephone Statistics of the World" is written in languages other than English, and ELIZABETH WRENSHALL finds her extensive travels and her two-year teaching experience in Rome have given her a facility in languages which is useful in gathering and compiling the data which she uses in her daily work. After making translations for the censorship authorities during World War II, Miss Wrenshall joined the A. T. & T. Company six years ago, and has been with the foreign statistics group in the Chief Statistician's Division of the Comptroller's Department for the past five years. To this MAGAZINE for Winter 1949–50 she contributed "This Country Leads the World in Telephones."

"Fifty Years With A. T. & T."

A FINANCIAL WRITER for the Wall Street Journal who has covered the American Telephone and Telegraph Company for 50 years recently devoted his column "Abreast of the Market" for November 8, 1950, to the growth of that company's financial structure and plant investment in the first half of the 20th century. Here's what he had to say:

"On November 8, 1900, fifty years ago, the editor of this column arrived in New York City and shortly thereafter went to work for Dow Jones. On November 8, 1900, the stock of American Telephone and Telegraph was selling on the Boston Stock Exchange at about the same price the stock is now selling on various exchanges throughout the country: $150 per share. Since that time, the authorized capital stock of A. T. & T. has increased from a million shares to 35 million through sales of additional shares of stock. Beginning in July, 1900, the annual dividend rate on this stock was set at $7.50 a share, and since 1922 the rate has been maintained at $9 a share. In 1900 the company was barely beginning its long program of public financing with an exchange of stock with the original American Bell Telephone Company. At that time the company had slightly less than a million instruments in use. Today the total is in excess of 34,326,000. A closer parallel between industrial expansion, taking the number of instruments in use, and the price of the capital stock would be difficult to find. Both are about 35 to one.

"While the editor of this column was covering A. T. & T. for The Wall Street Journal during the 1920s and the great depression of the 'thirties, he kept on hand for future use a form statement of the company's

coming dividend declarations. They never varied, a fact which has made the stock of A. T. & T. perhaps the prime investment in the nation today. Fifty years ago there were 7,536 stockholders. Today A. T. & T. has 971,000, including 40,100 trusts, corporations, charitable institutions, etc., with an average holding of 28.5 shares. This largest single corporation in the world, with plant and equipment worth nearly $10 billion and annual operating revenues of about $3 billion, today serves a nation of more than 150 million persons. And these people, through A. T. & T.'s systems, now carry on an average of 142 million telephone conversations per day."

"A Basic Policy for a Basic Service"

NEXT TIME you walk down Main Street in your home town, take a good look at the signs in front of the stores. . . . "Founded 1900" . . . "Established in 1880" . . . "Serving since 1922."

Yes, a business takes pride in the long years it has served the community. So do its employes, and the community, too. Actually, every year a firm remains in business is a vote of confidence by the public it serves: confidence in that firm's sound business management, confidence in its desire to give good merchandise or service at a fair price.

It is that way with the Bell System, too, which next March celebrates the 75th Anniversary of the invention of the telephone. Over the years the Bell System, like any other business, has been faced with grave problems, sometimes involving service, sometimes the welfare of our employes, sometimes safeguarding the stockholders.

Consistently, we have measured every problem against the basic policy of the Bell System, first publicly expressed many years ago. That policy, in brief, is "to provide the most telephone service and the best at the lowest cost consistent with financial safety and fair treatment for the employes."

Guided by that policy, the Bell System has always reached solutions that in the long run have made it a good place to work for the employe, a good investment for the stockholder, and its service the best in the world.

Thus, we can best maintain the confidence of the public, of our employes, and the hundreds of thousands of people who have invested part of their savings in the Bell System.

Telephone Story on the "Telephone Hour" radio program

"Three Ships"

A STORY IS TOLD of the student whose examination paper showed notable conciseness in explaining the outcome of a naval battle. The loser, he wrote, "lacked three ships:—seamanship, marksmanship, leadership."

He could have listed the same three "ships" had the question concerned the factors that go to make a successful business enterprise.

Seamanship: The ability to weather rough seas that are bound to trouble any enterprise from time to time. This means a soundly financed, sturdily built organization which combines human and physical re-

sources in such a way as to insure steadiness in any kind of going.

Marksmanship: The ability to hit objectives—not only those close at hand for today or tomorrow but those at a distance which require complex planning for the future.

Leadership: The direction of human activities with skill, with wisdom, and—above all—with the fairness and thoughtfulness that build all hands into a good-spirited crew.

Seamanship, marksmanship, leadership. These characteristics, with all that they imply, are the vital responsibilities of management.

They represent qualities that no business can do without. This is especially true in an enterprise such as ours. To manage the human activities and the equipment behind Bell System communications is to manage the most complex system of service the world has ever seen.

Times have changed since the old days when a man who owned a business always managed it too. The mill, the factory, the shop, the store were run by the men who put up the money. Thousands of businesses are still operated that way. But in the large businesses like ours a large group of people, usually starting at the bottom of the ladder and working up, now run the business for the owners, employees, and public.

These people are management. And management is a profession. It takes training, initiative, and farsightedness—or the three ships mentioned earlier.

Management people at all levels must make decisions. When added up, these decisions can affect, for good or bad, the future of the business, the security of employees, and the savings of investors.

All this is a large order. Success is determined by how well the "captains" know the seas.

From the "Items for Management" bulletin of the Long Lines Department of A. T. & T.

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